ICT Project Opportunities in Central America and The Caribbean

A Resource Guide for U.S. Industry

USTDA

U.S. TRADE AND DEVELOPMENT AGENCY

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The U.S. Trade and Development Agency

The U.S. Trade and Development Agency helps companies create U.S. jobs through the export of U.S. goods and services for priority development Projects in emerging economies. USTDA links U.S. businesses to export opportunities by funding Project planning activities, pilot Projects, and reverse trade missions while creating sustainable infrastructure and economic growth in partner countries.

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1 Introduction

The U.S. Trade and Development Agency (USTDA) helps companies create U.S. jobs by exporting U.S. goods and services for priority development projects in emerging economies. USTDA links U.S. businesses to export opportunities by funding project preparation and partnership building activities that develop sustainable infrastructure and foster economic growth in partner countries.

This guide provides U.S. companies and exporters an overview of infrastructure projects across the information and communications sector in several Central American and Caribbean countries, primarily over the next three years. Each of the countries and selected ICT project opportunities are profiled following. ICT Sector Overviews are provided in an Annex at the end of the Resource Guide.

Currency amounts are converted from local currencies to United States Dollars (USD) based on the current exchange rate when preparing this guide. Due to fluctuations in currency values, accuracy levels for engineering and cost estimates for different projects, and various timing of cost information publication, this report's monetary values should be considered approximate. Unless explicitly indicated otherwise, all currency values are in United States Dollars (USD).

1.1 Regional ICT Development

From an ICT development perspective, the countries covered in this Resource Guide, Belize, Costa Rica, the Dominican Republic, El Salvador, Grenada, Guyana, Haiti, Honduras, Jamaica, and the Organization of Eastern Caribbean States (OECS, herein including Dominica, Grenada, St. Lucia, and Saint Vincent and the Grenadines), are typically at or below the world averages in terms of telephone, internet, and broadband service usage on per capita bases. Most ICT sub-segments host private enterprises in the various countries, although the governments still control select elements.

The Latin American/Caribbean region, in total, represents approximately seven percent of the global ICT market and is generally growing faster than world averages. Within the region, Brazil is the largest ICT market, with an estimated three percent global share. Among the Latin America and Caribbean sub-region, Costa Rica is currently the largest ICT market with a sizable outsourcing labor pool. The country has hosted several large U.S. ICT companies over the past 25 years.

All of these countries are importers of ICT goods and services, with ICT goods imports alone representing two to 7.5 percent of all imports. Therefore, current supply opportunities for U.S. ICT technology providers are attractive.

The remainder of this Resource Guide defines specific sector opportunities relevant to U.S. exporters for the nine Latin American and Caribbean countries and the OECS.

1.2 Authors

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1.3 Acknowledgements

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2 Belize

2.1 ICT Demographics

Belize is a coastal Central American nation bordering the Caribbean Sea, Guatemala, and Mexico. The country is characterized by its flat, swampy coastal plain with low mountains in the south. Belize's landmass is 22,806 square kilometers (sq. km), slightly smaller than the U.S. state of Massachusetts in size. Over 60 percent of its land is forest.

Belize is home to 406,000 people, and more than half of the population is rural. Approximately 30 percent of the population lives in the former capital, Belize City. Population density is highest in the northern and eastern portions of the country.

2.2 ICT Sector Development

As measured by telephone, internet, and fixed broadband access, Belize's existing ICT sector is below world and regional levels. Belize is 145th and 173rd in the world in terms of total fixed broadband and mobile cellular subscriptions, respectively, while it stands at 112th and 150th globally, on a population-adjusted basis[1].

Belize ranks 120th globally in terms of percentage of its population with access to the internet. In 2017, 47 percent of the Belizean population had internet access.

Urban populations comprise only 46 percent of citizens to be served by ICT infrastructure in Belize.

Belize is connected to the ARCOS international cable system, which services the Latin America and Caribbean region, with a landing point near Belize City.[2] A 23 km domestic cable, SEUL, connecting the Belize mainland with San Pedro, Ambergris Cay, was a joint project of Belize Telemedia Ltd. and Huawei with a ready for service (RFS) date of 2017.

Government-owned Belize Telemedia upgraded its cellular phone network to 4G LTE ahead of most Central American countries. The company has also invested in a national fiber-optic network. The country has no satellites of its own.

2.3 Regulatory Landscape

The principal telecommunications regulator in Belize is the Public Utilities Commission (PUC). Under the Belize Telecommunications Act, 2002, the government liberalized telecommunications and appointed the PUC, which also oversees electricity and water, as the ITC industry regulator. Products using radio frequencies and cellular technologies require PUC certification and approval.

[1] Index Mundi https://www.indexmundi.com/facts/indicators/IT.NET.BBND/rankings
[2] Fiber Atlantic http://www.fiberatlantic.com/submarinecablemap/

Belize has privatized television and radio communications. The country hosts approximately 25 private radio stations. Eight privately owned television stations and multichannel cable television services provide entertainment to Belizean consumers.

The Central Information Technology Office (CITO) supports the Government of Belize's wide area network (GoB WAN) and provides a variety of governmental technology support, including:

- Ensuring the GoB WAN provides the required digital tools for stakeholders of the network;
- Ensuring database management systems are administered, maintained, and monitored;
- Providing network security, network management, and emergency recovery procedures;
- Evaluating, recommending, and advising on the selection and creation of IS/IT/ICT systems for, and on the behalf of, the Ministry of Finance;
- Developing IS/IT/ICT policies, standards, best practices, and guidelines for the GoB WAN;
- Providing leadership and guidance to the GoB and the public in IS/IT/ICT services; and
- Fostering strong professional relationships with private sector companies and local educational institutions in furthering the development of IS/IT/ICT in Belize.

2.4 ICT Sector Profiled

In late 2020, the Belizean Ministry of National Security, in collaboration with the Public Utilities Commission, launched the country's first cybersecurity strategy. The development of the strategy was guided by the Organization of American States and coordinated by the National Security Council Secretariat, the Public Utilities Commission, the Central Information Technology Office, the Attorney General's Ministry, and an Inter-institutional Cybersecurity Task Force. This Resource Guide reviews the project in Belize's Cybersecurity sector.

2.5 Projects Profiled

One Belize ICT project is profiled following (*Table 1*):

Table 1: ICT Development Project -- Belize

Project	Sponsor
Belize National Cybersecurity Strategy 2020-2023	Central Information Technology Office

Belize National Cybersecurity Strategy 2020-2023 \	
SUBSECTOR	**Cybersecurity**
LOCATION	**Belize**
PROJECT VALUE	**$10 million (estimated)**

PROJECT SUMMARY

- Belize published its National Cybersecurity Strategy 2020-2023 in November 2020.
- The strategy includes three key priorities:
  - Develop the national legal framework to address cybersecurity threats adequately;
  - Develop national capacity for incident response and protection of critical information infrastructure; and
  - Implement measures to support education, awareness, and workforce development in cybersecurity.

PROJECT BACKGROUND AND DESCRIPTION

Belize has experienced steady growth in the level of internet penetration and connectivity. The country's rapid digital growth has opened more avenues for cyberattacks.

The Police Information Technology and Cyber Unit (PITCU) of the Belize Police Department manages the investigations of cyber-related crimes and felonies involving electronic evidence. The PITCU has investigated phishing and credit card cases and ATM fraud and has also received reports of cyberbullying and identity theft. The PITCU holds a partnership with the Internet Watch Foundation, which facilitates international cybercrimes investigation and reporting.

Specific actions under the National Cybersecurity Strategy 2020-2023 are organized under 17 objectives grouped into three priorities as follows:

Priority 1: Develop a National Legal Framework to Adequately Address Cybersecurity Threats

1. Undertake a feasibility assessment of data retention / digital evidence regulation:
   a. Conduct a stakeholder consultation to identify gaps and prepare inputs for new legislation.
2. Develop minimum security standards for information systems used in critical infrastructure:
   a. Identify critical information infrastructure;
   b. Develop minimum security standards; and
   c. Establish a working group to review common threats.

3. Enact Cybercrime legislation:
    a. Establish a legal working group;
    b. Consult with international organizations, including OAS[3] and EC;[4] and
    c. Request the Attorney General to draft a cybercrime bill.
4. Create Cybercrime awareness for judges and prosecutors:
    a. Conduct quarterly briefings with Belize Police Department and National Security Council Secretariat;
    b. Assess judiciary training and awareness needs; and
    c. Organize training for the judiciary and prosecutors.
5. Create bilateral and multilateral cybersecurity arrangements:
    a. Review the process to accede to the Budapest Convention on Cybercrime; and
    b. Consider CARIMCOM and other treaties as needed for extradition and evidence sharing.
6. Build capacity of PITCU to address digital crime:
    a. Organize training in digital crime investigation;
    b. Leverage international and regional partners for annual training exercises; and
    c. Create a manual for cybercrime evidence management and first response.
7. Monitor and analyze cybercrime:
    a. Update the PITCU website to include cybercrime reporting; and
    b. Create an app for reporting cybercrimes, including cyberbullying.

Priority 2: Develop National Capacity for Incident Response and Protection of Critical Information Infrastructure

8. Conduct a feasibility assessment of incident response:
    a. Adopt an information sharing protocol across all key sectors; and
    b. Identify a list of sectoral cybersecurity incident response teams (CIRT).
9. Create a national CIRT:
    a. Develop a roadmap to establish a national CIRT;
    b. Develop the institutional and legal framework for the CIRT; and
    c. Train CIRT personnel and develop strategic capacity.
10. Provide user-friendly mechanisms to report incidents:
    a. Develop a publicly available incident reporting mechanism;
    b. Establish a multi-stakeholder advisory group; and
    c. Implement a national public awareness campaign.
11. International cooperation and new partnerships:
    a. Identify international partner agencies.
12. Develop measures to protect critical services:
    a. Conduct a risk/threat assessment to identify critical information systems;
    b. Develop incident response and recovery plans for critical assets; and
    c. Implement an awareness campaign for owners and operators of critical assets.

Priority 3: Implement measures to support education, awareness, and workforce development in cybersecurity

[3] OAS – Organization of American States
[4] EC – European Council

13. Develop initiatives and policies to support cybersecurity workforce development:
    a. Review existing cybersecurity workforce development frameworks;
    b. Carry out a cybersecurity workforce survey to prepare a national gap analysis;
    c. Develop a specific cybersecurity course curriculum;
    d. Create a national training catalog of cybersecurity-related courses; and
    e. Develop a national cybersecurity training/workforce development plan.
14. Initiate targeted cybersecurity awareness campaigns:
    a. Consult with all relevant stakeholders;
    b. Map existing cybersecurity initiatives and messages; and
    c. Implement awareness campaigns and the district and village level.
15. Create general public cybersecurity awareness:
    b. Prepare a cybersecurity communication strategy;
    c. Develop television ads for key consumer cybersecurity threats;
    d. Issue key cybersecurity messages through digital communication channels;
    e. Organize youth competitions focused on cybersecurity;
    f. Adopt international cybersecurity awareness messaging;
    g. Collaborate with Internet Service Providers (ISPs) for cybersecurity awareness; and
    h. Develop a specific cybersecurity campaign for large LEDs and billboards.
16. Provide cybersecurity education for youths:
    i. Carry out a national cybersecurity campaign targeted at youths; and
    j. Include cybersecurity components in existing youth forums.
17. Develop international cooperation and new partnerships:
    k. Develop a baseline cybersecurity awareness survey; and
    l. Develop surveys to measure the impact of cybersecurity awareness campaigns.

Belize is using the Cybersecurity Capacity Maturity Model for Nations, developed by the Global Cyber Security Capacity Centre of the University of Oxford[5]. Development of the tool included consultation with over two hundred international experts drawn from governments, international organizations, academia, public and private sector agents, and civil society. Initial analyses using the tool were carried out in 2016 and 2018. The tool will also be used to monitor the implementation of the strategy.

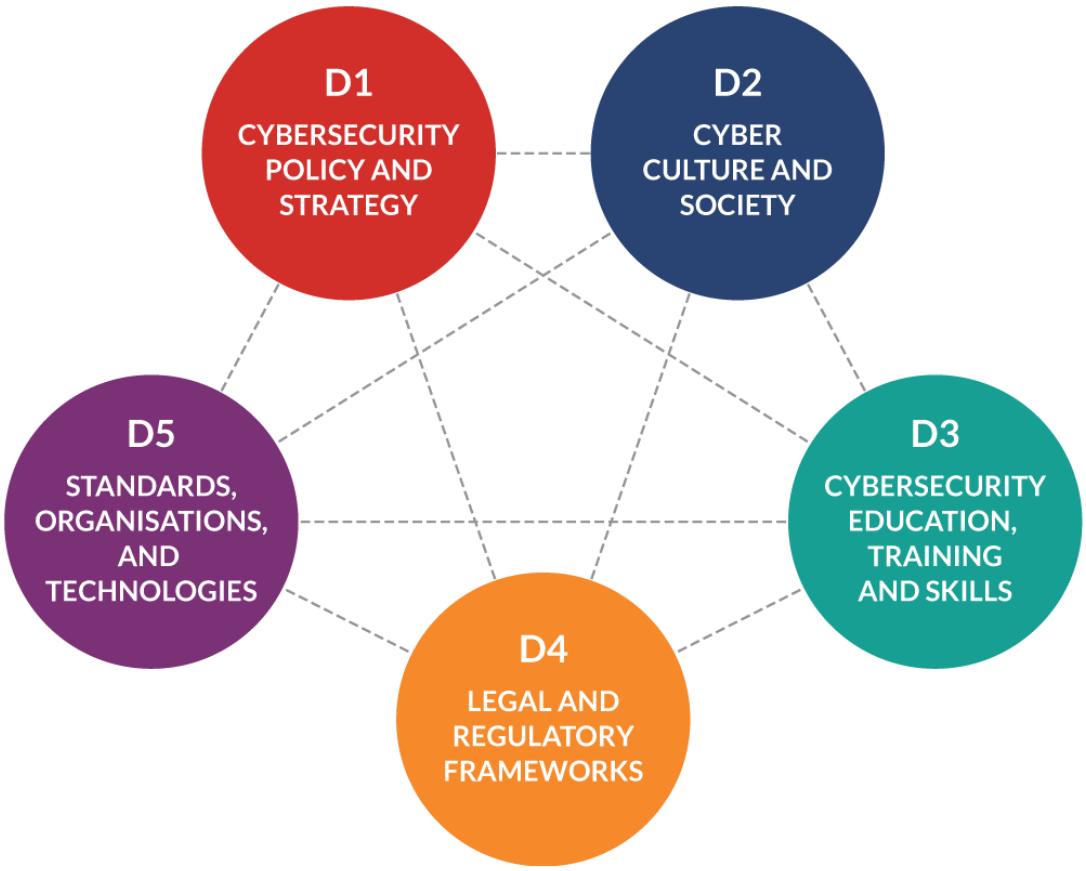
The tool reviews cybersecurity capacity from 24 indicators organized among five dimensions:

1. Cybersecurity Policy and Strategy;
2. Cyber Culture and Society;
3. Cybersecurity Education, Training and Skills;
4. Legal and Regulatory Frameworks; and
5. Standards, Organizations, and Technologies.

The interrelationships among these five dimensions are depicted in Figure 1.

[5] https://cybilportal.org/tools/cybersecurity-capacity-maturity-model-for-nations-cmm-revised-edition/

Figure 1: The Five Dimensions of the Cybersecurity Capacity Maturity Model for Nations[6]



Belize's National Cybersecurity Strategy 2020-2023 was developed with support from the OAS and financing from the United Kingdom. The process commenced in 2018 with a holistic stakeholder engagement plan, including:

- A multi-stakeholder task force, set up under the leadership of the Government's National Security Council Secretariat (NSCS);
- Capacity building for civil society actors;
- Open online consultation for the first draft; and
- A multi-stakeholder workshop to present the draft strategy and gather input.

The process culminated in November 2020 with the publication of the definitive strategy.

PROJECT STATUS AND IMPLEMENTATION TIMELINE

The Belize National Cybersecurity Strategy 2020-2023 was launched in November 2020 with a completion timeframe through 2023. Each action has its own implementation timelines. Actions with shorter timelines include those to create an enabling legal framework. Actions with a longer timeline tend to be related to the development of critical information infrastructure.

[6] Global Cyber Security Capacity Centre https://gcscc.ox.ac.uk/the-cmm#/

PROJECT COST AND FINANCING

The strategy assigns lead and partnering coordination responsibilities to specific entities for each of the 17 objectives. Project implementation, thus, does not involve a single entity with an overarching budget but instead is distributed among dozens of entities, each with its own respective budgets. The National Cybersecurity Strategy 2020-2023 does not contain a formal budget estimate.

The two entities with the greatest responsibilities for implementing the Cybersecurity Strategy are the Belize Police Department (Ministry of National Security) and the Central Information Technology Office (CITO, within the Ministry of Finance). Based on the annual budgets of these two entities, we estimate implementation of the strategy over four years will require approximately $10 million.

U.S. EXPORT OPPORTUNITIES

Export opportunities for U.S. companies, in support of Belize's National Cybersecurity Strategy, include:

- Cybersecurity software and solutions;
- Specialized cybersecurity advisory services:
  - Legal framework;
  - Risk assessment; and
  - Training and awareness.

CONTACTS

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3 Costa Rica

3.1 ICT Demographics

Costa Rica is a Central American nation bordering the Caribbean Sea and the North Pacific Ocean and Nicaragua and Panama. The country is characterized by coastal plains and rigged mountains, including over 100 volcanic cones, several of which are active. Costa Rica's landmass is 51,060 sq km, slightly smaller than the U.S. state of West Virginia in size. Over 60 percent of its land is forest. The country is subject to hurricanes, occasional earthquakes, flooding of lowland areas and landslides, and volcanic eruptions.

Costa Rica is home to 5.2 million people. Approximately 30 percent of the population lives in the capital city of San José.

3.2 ICT Sector Development

As measured by telephone, internet, and fixed broadband access, Costa Rica's existing ICT sector is below world and regional averages on a total subscriptions basis due to its relatively small population but more competitive when viewed on a per capita basis. Costa Rica is 72nd and 94th in the world in terms of total fixed broadband and mobile cellular subscriptions, respectively, while it stands at 73rd and 9th globally on a population-adjusted basis[7]. Urban populations comprise well more than half of citizens to be served by ICT infrastructure in Costa Rica.

Costa Rica ranks 66th globally in terms of the percentage of its population with access to the internet. In 2018, 47 percent of the Costa Rican population had internet access[8].

Costa Rica is a landing point for three international, subsea telecommunications cables, two landings on the country's east coast and one on its west coast.[9] The 8,600 km regional ARCOS cable lands at Puerto Limon in the Caribbean Sea, as does the 4,400 km Maya-1 cable servicing Colombia, Panama, Costa Rica, Honduras, Mexico, the Cayman Islands, and the United States. The 10,000 km Pan American Crossing (PAC) cable connects Panama, Costa Rica, Mexico, and the Western United States via the Pacific Ocean.

Three principal operators, Claro, Kölbi, and Movistar, service the Costa Rican mobile telephone market, which currently includes 2G, 3G, and 4G services. The entry of 5G technology has been delayed due to the COVID-19 global pandemic. Costa Rica launched its first satellite in 2018.

[7] Index Mundi
[8] World Bank
[9] Fiber Atlantic http://www.fiberatlantic.com/submarinecablemap/

3.3 Regulatory Landscape

The principal telecommunications regulator in Costa Rica is Superintendencia de Telecomunicaciones (SUTEL). The agency functions as both regulator and competition authority to guarantee the rights of users and the universality of service. SUTEL also serves as a technical authority and seeks to align the interests of various parties in developing a connected society. SUTEL approves telecommunications products and devices, including:

- Cellular telephones
- Trackers
- RFID
- WiFi
- Bluetooth

The Costa Rica Communications Ministry (Micitt) regulates, promotes, and boosts the development of favorable conditions for research, innovation, knowledge, and technology to contribute to the country's economic growth.

Costa Rica enjoys the most advanced broadband network in the Central American region with the highest regional broadband penetration. Costa Rican telephone service also offers a good breadth of coverage.

Costa Rica has one publicly-owned television station and multiple private ones, with widely available cable network television services. One public and over 100 private radio stations also serve the nation.

3.4 ICT Sectors Profiled

This Resource Guide reviews three Costa Rican development projects, spanning the following ICT sectors:

- *Terrestrial Telecommunications Network Infrastructure: Telephone, Internet, and Broadband*: Costa Rica enjoys the most advanced broadband network in the Central American region with the highest regional broadband penetration. Costa Rican telephone service also offers a good breadth of coverage. A current focal area is providing enhanced telecommunications capabilities to indigenous communities.

- *Smart Cities and e-Government*: Micitt opened a large smart community center in Cartago in 2015 and since has been pursuing other smart community and city developments, as well as digital government, digital signature, and cybersecurity programs and projects for Costa Rica. The ministry leads Costa Rica's Digital Transformation Strategy, 2018-2022. The strategy includes the following focal areas:

    - Digital government
    - Pure digital life
    - Smart Costa Rica
    - Digital business transformation

- Innovation
- Costa Rican connectivity

- *Internet of Things (IoT) and Artificial Intelligence (AI)*: IoT is already one of the most common 4.0 technologies being adopted by companies located in Costa Rica, with Intel, Hewlett Packard, and other U.S. companies involved. Several AI efforts, both public and private, are also underway in Costa Rica. In AI, the Costa Rica Institute of Technology (ITCR), in concert with the U.S. Smithsonian Institution, uses NVIDIA's technology to study big data analytics and computer vision and enhance knowledge of botanical information. Microsoft, which has been resident in the country since 1995, is supporting the country's digital transformation with Cloud and AI technologies. Intel is using AI-equipped drones to map forest terrain and assess soil carbon capture. Genpact, expanding its relationship with Wal-Mart, is opening a new finance and accounting center in Heredia using a platform offering easy implantation of AI.

3.5 Projects Profiled

The Costa Rican ICT projects are profiled following (*Table 2*):

Table 2: ICT Development Projects – Costa Rica

Project	Sponsor
Costa Rica Fiscal Management Improvement Project	Ministry of Finance
Network Rollout for Indigenous Communities	Grupo ICE
Innovation District T24	Municipalidad de San José

Costa Rica Fiscal Management Improvement Project	
SUBSECTOR	**Smart Cities and e-Government**
LOCATION	**Costa Rica**
PROJECT VALUE	**$157 million**

PROJECT SUMMARY

- The Costa Rica Fiscal Management Improvement Project will improve the efficiency, effectiveness, and client orientation of tax and customs administration and public expenditure management.
- The project comprises five components:
  - Strengthening public expenditure management;
  - Enhancing efficiency and client orientation of tax administration;
  - Enhancing customs controls and services;
  - Strengthening the technological, institutional, and operational environment; and
  - Project management and capacity building.
- The project duration is five years and is funded by a $156.64 million loan from the World Bank Group.

PROJECT BACKGROUND AND DESCRIPTION

The objective of the Costa Rica Fiscal Management Improvement Project is to improve the efficiency, effectiveness, and client orientation of tax and customs administration and public expenditure management. The project will be implemented by the Ministry of Finance (MOF). The project comprises five components as described below:

Component 1: Strengthening Public Expenditure Management
Subcomponent 1.1: Strengthening Expenditure Policy and Planning
Subcomponent 1.1 seeks to improve the policy alignment and effectiveness of public expenditures by financing technical assistance and training in support of:

- Development of a fiscal management strategy;
- Design and application of tools for evidence-based decision making, including periodic spending reviews and program evaluations;
- Integration of climate change, disaster risk management, and gender considerations in expenditure planning;
- Strengthening public investment practices in portfolio and asset management and expenditure planning;
- Systematic application of program and results-informed budgeting;
- Consolidation of fiscal information and reporting for fiscal management purposes; and

- Strengthening the oversight unit's governance and policy functions at selected state-owned enterprises.

Subcomponent 1.2: Streamlining and Control of Public Expenditure Cycle
Subcomponent 1.2 seeks to improve the functional integration, reliability, and timeliness of information and processes throughout the public expenditure cycle by financing technical assistance and training for:

- Reviewing and updating the public expenditure cycle institutional, legal and operational framework;
- Simplifying and streamlining public financial management processes and procedures;
- Expanding the single treasury account;
- Applying accounting and financial reporting international standards;
- Improving in arrears management and controls;
- Strengthening capacity to design and implement a debt management strategy, an issuance program, and a price discovery system;
- Streamlining income registration for budget and accounting; and
- Strengthening payroll controls and asset management procedures.

Subcomponent 1.3: Modernizing Public Financial Management Information System
Subcomponent 1.3 seeks to modernize and integrate public financial management information systems through enhancements in their functionality, technology, and interconnectivity. The system will cover at least the following functions as an integrated software solution:

- Budget preparation;
- Budget authorization;
- Commitment of funds;
- Payments and receipts management;
- Cash management;
- Accounting (automatic and registration);
- Debt and aid management;
- Public investment management;
- Asset and inventory management;
- Payroll calculation; and
- Human resource management.

Component 2. Enhancing Efficiency and Client Orientation of Tax Administration
Subcomponent 2.1: Streamlining and Automating Core Tax Processes
Subcomponent. 2.1 seeks to streamline and automate operational processes of the General Directorates for Taxation and Customs by:

- Mapping and reengineering core tax administration business processes;
- Developing functional and technical requirements and bidding documents for new tax administration software;

- Implementing an integrated tax information management system to automate refined processes and support the planning, execution, control, and monitoring of fiscal management;
- Developing a robust taxpayer current account and an integrated tax compliance model;
- Developing a case manager for administration and tracking of internal issues and taxpayers procedures;
- Improving the taxpayer registry and e-invoicing functionality;
- Developing digital services for tax; and
- Updating the existing tax administration system regulatory framework to implement and sustain the updated processes, technologies, and systems.

Subcomponent 2.2: Improving Citizen and Business Taxpayer Services

Subcomponent 2.2 seeks to improve citizen and business taxpayer services by implementing client-facing applications. These applications include multi-channel access points and mobile apps for taxpayer registration, e-filing, automated helpdesk, and online access to taxpayer records and profiles.

Subcomponent 2.3: Design and Implementation of a Comprehensive Compliance Strategy

Subcomponent. 2.3 seeks to strengthen compliance management through the design and implementation of a comprehensive, targeted, and risk-based compliance strategy by:

- Designing and implementing an integrated risk management system;
- Introducing advance audit techniques and mechanisms to automatically match third-party information and enable more effective detection of tax evasion and fraud;
- Reforming the appeal system to reduce contact between tax officials and taxpayers; and
- Introducing risk management activities through the use of an advanced data analytics platform.

Component 3. Enhancing Customs Controls and Services

Subcomponent 3.1: Strengthening Customs Controls and Clearance Procedures

Subcomponent 3.1 seeks to strengthen customs controls and clearance procedures by:

- Mapping and reengineering core customs administration business processes;
- Developing the requirements and bidding documents for a new customs management system;
- Enhancing cooperation and training across sectors;
- Updating the customs administration regulatory framework;
- Implementing tools and methodologies to improve the efficiency and effectiveness of the customs administration;
- Acquiring a modern customs management system and customer relationship management software;
- Creating an operational policy and sustainability strategy for the adoption of modern technologies with better control of data for intelligence and risk management; and
- Acquiring laboratory equipment and other tools to improve connectivity, mobility, and productivity.

Subcomponent 3.2: Improving Trade Facilitation Services
Subcomponent 3.2 seeks to improve trade facilitation services by providing financing for:

- Providing technical support to accelerate the release and clearance of goods;
- Developing digital services and online and mobile applications to ease trade services;
- Developing a trade information portal;
- Providing support for data integration between customs, the single trade window, and other border agencies to expedite border clearance and provide accurate information;
- Providing training on new procedures for traders; and
- Carrying out time-release studies and activities to reduce bottlenecks in trade processes.

Subcomponent 3.3: Implementing a Risk-Based Framework and Post-Clearance Audit
Subcomponent 3.3 seeks to implement a robust risk management framework to promote more efficient use of information sources for customs auditing, control, and enforcement by:

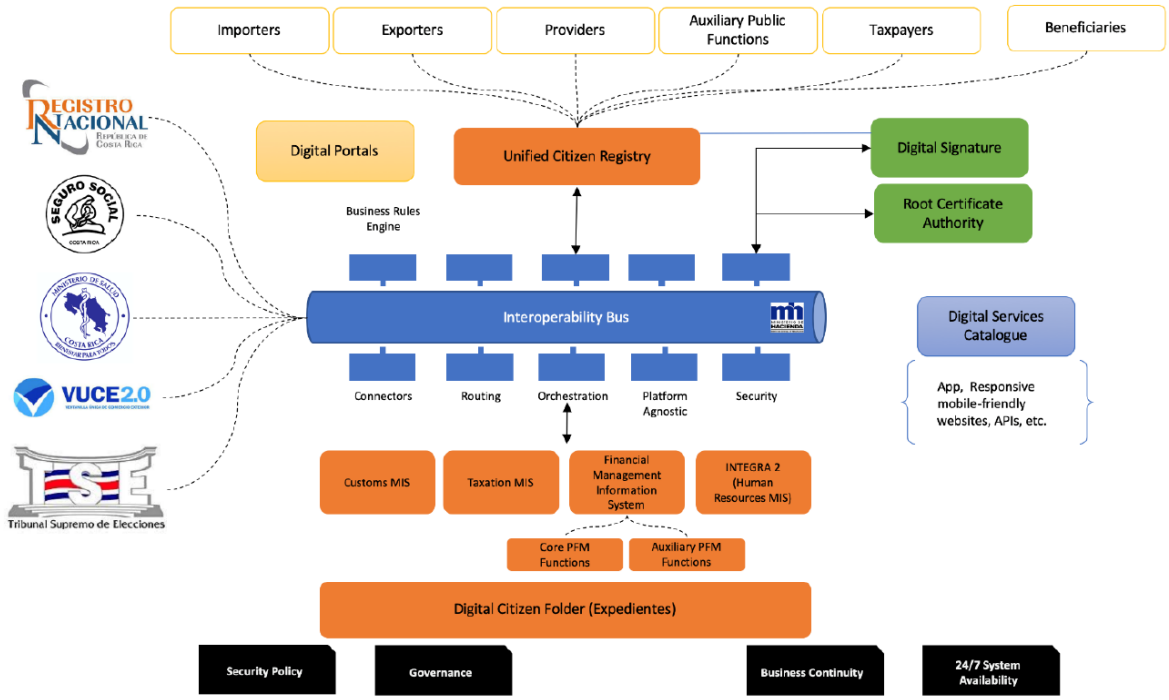
- Carrying out an assessment and the provision of support for the implementation of successful and good practice customs initiatives;
- Acquiring non-intrusive technologies to support risk management; and
- Providing technical assistance to prepare a data integration model for the core customs processes.

Component 4. Strengthening the Technological, Institutional, and Operational Environment
Subcomponent 4.1: Strengthening Human Resource Management
Subcomponent 4.1 seeks to strengthen the MOF's human resource management functions by:

- Developing and implementing an integrated human resources management strategy;
- Updating staffing plans for revenue and expenditure administrations;
- Establishing a robust performance and career management framework;
- Defining a rigorous screening process for staff recruitment;
- Implementing and strengthening an internal capacity development and knowledge management program for the MOF;
- Developing the requirements and bidding documents for a human resource management information system (HRMIS);
- Implementing a web-based HRMIS to support decentralized operations;
- Modernizing human resources systems and internal communication models;
- Improving the MOF human resources' internal audit function and internal investigation unit; and
- Designing and implementing a comprehensive transparency strategy.

Subcomponent 4.2: Modernization and Integration of the MOF's Information Technology Infrastructure
Subcomponent 4.2 seeks to modernize and integrate the MOF's information and communication technology infrastructure and provide support for implementing the digital transformation agenda, as shown in Figure 2.

Figure 2: Digital Transformation and Modernization Based on a Service-Oriented Architecture



Subcomponent 4.3: Operational Support and Change Management.
Subcomponent 4.3 provides operational support, and finances change management activities by:

- Providing technical assistance to manage and provide quality assurance of bidding documents, proposals, and deliverables of information and communication technology;
- Carrying out capacity-building activities to institute envisaged reforms and achieve expected results;
- Implementing a change management strategy; and
- Carrying out management capacity-building activities and a public education campaign.

Subcomponent 4.4: Flexible Technical Assistance
Subcomponent 4.4 provides financing to address technical and policy issues to support the MOF's reform process.

Component 5. Project Management and Capacity Building
Component 5 provides:

- Project management and monitoring;
- Compliance, internal controls, and audits for the project; and
- Stakeholder outreach activities.

PROJECT STATUS AND IMPLEMENTATION TIMELINE

The financing agreement for the Costa Rica Fiscal Management Improvement project was signed on April 6, 2020. The project's target completion date is December 2025. The projected completion targets by fiscal year are shown in Table 3:

Table 3: Costa Rica Fiscal Management Improvement Project Completion Targets

Fiscal Year Ending June 30:	Yearly Completion	Cumulative Completion
2021	5.4%	5.4%
2022	18.0%	23.5%
2023	41.6%	65.0%
2024	18.5%	83.5%
2025	10.9%	94.5%
2026	5.5%	100.0%

The project will prepare annual operational plans and budgets specifying activities by project components and subcomponents.

PROJECT COST AND FINANCING

The Costa Rica Fiscal Management Improvement Project is financed under a $156.64 million loan provided by the IBRD (International Bank for Reconstruction and Development, World Bank Group). The budget breakdown by project component is described in Table 4:

Table 4: Costa Rica Fiscal Management Improvement Project Component Budgets

Project Component	Budget, $ Million
1. Strengthening Public Expenditure Management	44.44
2. Enhancing the Efficiency and Client Orientation of Tax Administration	28.46
3. Enhancing Customs Controls and Services	52.34
4. Strengthening the Technological, Institutional, and Operational Environment	23.00
5. Project Management and Capacity Building	8.40
Total Budget	***156.64***

The project will be financed entirely with International Bank for Redevelopment (IBRD) loan proceeds, without the government of Costa Rica providing counterpart funding.

U.S. EXPORT OPPORTUNITIES

The project budget contemplates acquiring over $100 million of equipment, consulting services, and non-consulting services. U.S. technology company capabilities align well with these needs. The goods and services to be procured under this project are summarized in Table 5:

Table 5: U.S. Export Opportunities under the Costa Rica Fiscal Management Project

Category of Goods and Services	Budget, $million
Scanners	25.00
Integrated Financial Management Information System	19.00
Customs Administration System	18.00
Tax Administration System	16.50
Other Non-Consulting Services	13.14
Consulting Services	8.38
Other Equipment	6.10
Total Budget	***106.12***

CONTACTS

Project Sponsor	U.S. Trade and Development Agency	U.S. Commercial Service
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Network Rollout for Indigenous Communities	
SUBSECTOR	**Terrestrial Communications Infrastructure: Telephone, Internet, and Broadband**
LOCATION	**Costa Rica**
PROJECT VALUE	**$48 million**

PROJECT SUMMARY

- The project will provide telephone services and Internet access to 14 of Costa Rica's 24 indigenous territories: six in the Atlantic Zone and eight in the Southern Zone.
- This program covers 119 public services centers, including schools and health centers.
- The project builds on a pilot that connected the first three indigenous territories, completed between 2016 and 2019.
- Project initiation was delayed until early 2021 due to the COVID-19 global pandemic.
- A future phase will connect the remaining indigenous communities.

PROJECT BACKGROUND AND DESCRIPTION

Fondo National de Telecomunicaciones (the national telecommunications fund, or FONATEL) aims to bring telephony and internet access to areas and communities with no current service. FONATEL is an instrument of the National Telecommunication Development Plan and the General Telecommunications Law No. 8642, promoting universal access, service, and solidarity, according to the National Telecommunication Development Plan's priorities. FONATEL is managed by the Superintendencia de Telecomunicaciones (the telecommunications superintendency, or SUTEL)

FONATEL develops projects to roll out telecommunications infrastructure to:

- Bring telephone services and internet access to remote areas;
- Deliver computer equipment and computers to low-income families; and
- Provide free internet service at health centers, smart community centers, schools, and internet access points (parks, squares, train stations, and public libraries).

With these measures, FONATEL expects to reduce the digital gap and ensure greater development opportunities.

FONATEL includes four program areas:

1. Connected Communities;
2. Connected Households;
3. Public Centers; and

4. Public Spaces.

Under the first program area, Connected Communities, FONATEL includes specific commitments to connect indigenous territories. FONATEL's progress to date and commitments through 2027 are described in Table 6.

Table 6: FONATEL Programs and Progress

FONATEL Program		Completed as of Nov 2020, $000	Commitments 2021-27, $000
1	Connected Communities	34.7	144.2
	Program in Indigenous Communities	*11.8*	*77.2*
2	Connected Households	108.7	157.8
3	Public Centers	16.8	60.0
4	Public Spaces	8.7	170.5
Total		***171.0***	***180.6***

In March 2019, Grupo ICE[10], the national electricity and telecommunications entity, delivered the first connected indigenous community, Matambú, under contract with SUTEL, the national telecommunications regulator. An example of Matambú is shown in Figure 3.

Figure 3: IT Laboratory in Matambú School

[10] ICE – Instituto Costarricense de Electricidad

Specific benefits showcased from this pilot experience include:

- The IT laboratory in the local school now has 16 connected laptops. University students also use the IT lab during the evening hours.
- A micro company for garment assembly and embroidery now presents offers and receives orders and artwork to embroider via the internet, increasing efficiency and business volume.
- A pottery artisan can now accept payment via credit cards, increasing sales.

In March 2020, SUTEL, as the administrator of FONATEL, signed two contracts with Grupo ICE to connect an additional 14 of the country's 24 indigenous territories. The location of Costa Rica's eight indigenous peoples and the 24 territories they inhabit are described in Figure 4.

Figure 4: Map of Indigenous Peoples and Territories in Costa Rica

The project's geographic scope covers six indigenous territories in the Atlantic Zone and eight in the Southern Zone:

- **Atlantic Zone**:
    1. Cabécar Tayní;
    2. Talamanca;
    3. Bajo de Chirripó;
    4. Altos de Chirripó;
    5. Bribrí de Talamanca; and
    6. Keköldi.

- **Southern Zone**:
    1. Guaymí de Conteburica;
    2. Altos De San Antonio;
    3. Abrojos-Montezuma;
    4. Brunka de Curre (Rey Curre);
    5. Térraba;
    6. Cabécar de Ujarrás;
    7. Bribrí de Salitre; and
    8. Cabagra.

The principal elements of the two new contracts are described in Table 7:

Table 7: Project Elements

Zone	*Territories*	*Population Clusters*	*Schools*
Atlantic	6	55	57
Southern	8	69	62
Total	***14***	***124***	***119***

PROJECT STATUS AND IMPLEMENTATION TIMELINE

The pilot phase of the program, connecting Matambú, Maleku, and Quitirrisí under a separate contract, was completed from 2016 to 2019.

The tenders for the two zones were launched in 2018. Grupo ICE, the sole bidder, was selected in 2019. The contracts between SUTEL and Grupo ICE were signed in March 2020. Activity initiations under the contracts were promptly suspended due to the COVID-19 global pandemic, with the parties citing two issues:

1. The need for epidemiological boundaries to protect the indigenous communities from outside infection; and
2. Grupo ICE network development priorities to support online schooling for children.

In January 2021, the parties signed a modified timetable for project implementation:

- Four territories are to come online in 2021:
  Atlantic Zone
  1. Talamanca Cábecar (Atlantic. Zone); and
  2. Tayni;

  Southern Zone
  3. Rey Curré; and
  4. Salitre (Southern Zone); and
- The remaining ten territories will come online in 2022.

FONATEL is planning an additional phase of seven indigenous territories to be tendered in the future so that all 24 ultimately become connected.

PROJECT COST AND FINANCING

The project investment to connect the 14 indigenous territories is estimated to be $47.9 million:

- $27.6 million for the six communities in the Atlantic Zone; and
- $20.2 million for the eight communities in the Southern Zone.

Project financing is contemplated within the contracts signed between Grupo ICE and SUTEL.

U.S. EXPORT OPPORTUNITIES

The network rollout for indigenous communities offers several opportunities for U.S. companies, including:

- Antennae systems, hardware, and software;
- Fiber optic network hardware and spares;
- Network and location system hardware and software;
- Small- and pico-cell technologies and equipment;
- Wireless telecommunications equipment;
- IT laboratory equipment;
- Batteries/battery storage solutions;
- Renewable ICT technologies, including photovoltaics; and
- Advisory services.

CONTACTS

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Innovation District T24	
SUBSECTOR	**Terrestrial Communications Infrastructure: Telephone, Internet, and Broadband** **Smart Cities and e-Government** **Internet of Things (IoT) and Artificial Intelligence (AI)**
LOCATION	**San José, Costa Rica**
PROJECT VALUE	**>$100 million**

PROJECT SUMMARY

- The Innovation District T24 combines urban redevelopment with San José's first 5G network rollout to create a technological city.
- The District will focus on attracting companies and ventures in four areas:
  - Artificial intelligence;
  - Value-added services including big data;
  - Creative industries based on computing; and
  - Life sciences.
- Anchor tenants for the project include Microsoft and the host country's leading technological institutions.

PROJECT BACKGROUND AND DESCRIPTION

San José´s Innovation District T24 will be a technological city committed to hosting companies specializing in research and development (R&D) and innovation and incubators and accelerators of new ventures. The District will also host the headquarters of the Technological Institute of Costa Rica (TEC). Target sectors for the District include:

- **Artificial Intelligence** - the municipality aims to attract companies generating research and development in artificial intelligence uses in daily city life: urban mobility, security, health, education, and social coexistence.
- **Value-added Services** - activities will include customer service, accounting, legal sciences, human resources, and management of operations that will go hand in hand with technologies such as artificial intelligence and big data.
- **Creative Industries** – San José seeks companies that combine computing with creativity, digital animation, audiovisual production, video games, and other related areas.
- **Life Sciences** – the foci here are the design and construction of medical devices, companies incorporating new technologies into medicine, and installing research laboratories.

Torre Universal is the first building to be constructed within the Innovation District T24 and is shown in Figure 5. The 24-floor structure has a constructed area of over 80 thousand square meters. An artist's rendering of the entire Innovation District T24 is provided in Figure 6.

Figure 5: Torre Universal, the First Building of the Innovation District T24

Figure 6: Artist's Rendering of the Innovation District T24

Microsoft is the anchor rental client for Torre Universal. Other tenants include the development initiative coalition CINDE[11], Banco Proamérica, and a Universal department store.

Another element of the Innovation District T24 is the Technology City Building, which will be constructed on an 18,000 square meter lot owned by the municipality. This building will house R&D labs and business incubators. Costa Rica's technology institute TEC[12] will be a key player in this building, an artist's rendering of which is shown in Figure 7.

Figure 7: Artist's Rendering of the Technology City Building

The project includes 5G and fiber optic network capabilities. Grupo ICE will roll out the 5G network. The project also contemplates a highly reliable and renewable power supply.

PROJECT STATUS AND IMPLEMENTATION TIMELINE

The following milestones have been achieved:

- Early 2018: the municipal government announced the project.
- August 2018: the municipal government announced a competitive process to select a private sector partner for the project.

[11] CINDE - Coalición Costarricense de Iniciativas de Desarrollo
[12] TEC – Tecnológico de Costa Rica

- October 2018: Microsoft announced it would locate at the Torre Universal.
- May 2019: the deadline for submitting PPP offers.
- April 2020: IFC and the municipal government signed a $12 million loan to support the project's infrastructure.
- August 2020: the inauguration of the Torre Universal.

The project has suffered two setbacks:

- The municipal government declared the PPP tender null, considering the single offer received not responsive. The offeror appealed, obtaining a partial injunction.
- In May 2020, ICE announced its 5G rollout delays, including the 5G network for this project. During the COVID-19 global pandemic, ICE modified its priorities to reinforce network support of telemedicine provided by the Costa Rican Social Security Fund. ICE indicated it would make future decisions concerning the 5G rollout, including this project, during 2021.

San José expects the next phase of project development to be spurred by the urban infrastructure to be financed by the IFC loan and the Grupo ICE 5G pilot rollout.

PROJECT COST AND FINANCING

The Universal department store chain and Banco Proamérica developed Torre Universal. The building's construction costs were $50 million.

Financing sources vary for other project components:

- The $12 million loan from the IFC to the municipality of San José will finance urban infrastructure along the T24 corridor;
- Grupo ICE will finance and build out the 5G network for the entire Innovation District;
- The Technology City Building will be developed under a PPP, with the municipality providing the 18,000 square meter lot and the private sector partner raising the remaining funds necessary for construction; and
- Future development will be carried out either by the PPP or by private developers.

The overall budget exceeds $100 million.

U.S. EXPORT OPPORTUNITIES

Export opportunities for U.S. companies for Innovation District T24 will include:

- ICT and power supply infrastructure:
  - 5G network equipment and rollout;
  - Fiber optic network hardware and installation technology; and
  - Reliable power supply.

- Equipment, systems, and support for the Technology City Building:
  - General/office IT/communications equipment, software, technical support, and training;
  - Video conferencing technology;
  - Office furniture and fittings;
  - Education, training, and professional certification applications design, implementation, and support;
  - Specialized R&D and technology development equipment and training;
  - Financial and intellectual property-related software and support services; and
  - Entrepreneurial and technology management support and training.

In addition, tenants of the Innovation District T24 will have the ability to create enhanced export opportunities throughout the Central America region.

CONTACTS

Project Sponsor	U.S. Trade and Development Agency	U.S. Commercial Service
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4 Dominican Republic

4.1 ICT Demographics

The Dominican Republic (DR) is characterized by mountains, rugged highlands, and fertile valleys. The DR's landmass is 48,320 square kilometers (sq km), slightly more than twice the size of the U.S. state of New Jersey. Over 50 percent of the country's land is agricultural. The country is in the middle of the Atlantic/Caribbean hurricane belt.

The DR is home to 10.7 million people. Population density is highest in the southern coastal plains and in the Cibao Valley, where development has been extensive. The interior mountains (Cordillera Central) host smaller population centers.

4.2 ICT Sector Development

As measured by telephone, internet, and fixed broadband access, the DR's existing ICT sector is well below world and regional averages. The DR is 73rd and 90th in the world in terms of total fixed broadband and mobile cellular subscriptions, respectively, while it stands at 106th and 152nd globally on a population-adjusted basis[13].

The DR ranks 62nd globally in terms of the percentage of its population with access to the internet. In 2018, approximately 75 percent of the population had internet access[14].

Urban populations comprise 83 percent of citizens to be served by ICT infrastructure in the DR.

The DR is a landing point for four subsea telecommunications cables:

- The 17,800 America Movil Submarine Cable System-1 (AMX-1) connects the Americas, landing at Puerto Plata in the DR;
- The 8,600 km ARCOS regional cable lands at both Puerto Plata and Punta Cana;
- The 1,750 km East-West cable links the British Virgin Islands and Jamaica with the DR at Haina; and
- The 1,000 km Fibralink cable connects Jamaica, Haiti, and the DR at Puerto Plata. [15]

The DR is in the process of tendering for 5G technology during 2021. The country has no satellites of its own.

4.3 Regulatory Landscape

The principal telecommunications regulator in the DR is the Instituto Dominicano de Telecomunicaciones (INDOTEL), which regulates and supervises the country's

[13] International Telecommunications Union
[14] World Bank
[15] Fiber Atlantic http://www.fiberatlantic.com/submarinecablemap/

telecommunications market well as serving as the government's telecommunications policy arm. INDOTEL promotes the development of domestic telecommunications with the ultimate goal of implementing universal service to ensure sustainable, fair, and effective competition in the public telecom sector. The regulator also enforces the rights of customers, users, and providers and ensures efficient use of radio spectrum in the public domain.

The DR operates one public television network with several privately-owned broadcast media operators in addition. The country has more than three hundred radio stations, a combination of privately-held and state-owned.

4.4 ICT Sector Profiled

This Resource Guide reviews one development project in the DR Terrestrial Communications Network Infrastructure: Telephone, Internet, and Broadband sector. Development activities include the nation's 2021 5G tender activities, fiber optic network extension, and a digital terrestrial television roadmap development.

4.5 Projects Profiled

One DR ICT project is profiled as shown in Table 8:

Table 8: ICT Development Project – Dominican Republic

Project	Sponsor
The Dominican Republic's Broadband Plan	INDOTEL

Dominican Republic's Broadband Plan	
SUBSECTOR	**Terrestrial Communications Network Infrastructure: Telephone, Internet, and Broadband**
LOCATION	**Dominican Republic**
PROJECT VALUE	**>$300 million**

PROJECT SUMMARY

- The Dominican Republic's National Broadband Plan will fast-track three key initiatives:
  - The 5G auctions, during 20201, of 90MHz in the 700HMz band and 160MHz in the 3.5GHz band;
  - Providing access to the power transmission company's fiber-optic backbone; and
  - Implementing a digital terrestrial television roadmap by 2022.
- Through a roundtable process with relevant stakeholders, further developments of the plan will include:
  - Providing universal access at affordable prices;
  - Enabling digital transformation of the public sector; and
  - Breaching the digital gap compared to the Latin America and Caribbean (LAC) region.

PROJECT BACKGROUND AND DESCRIPTION

Dominican Republic Decree 539-20, signed on October 7, 2020, declares the essential right of universal access to leading-edge broadband internet and the productive use of information and communication technologies as of the utmost national interest. The Decree also initiates the National Broadband Plan and specifically fast tracks the country's 5G auction for 2021.

The right to universal access and productive use of information and communication technologies was established in 2012 in the National Development Strategy 2030. This strategy also called for the implementation of a national backbone and capillary fiber optic networks with two key objectives:

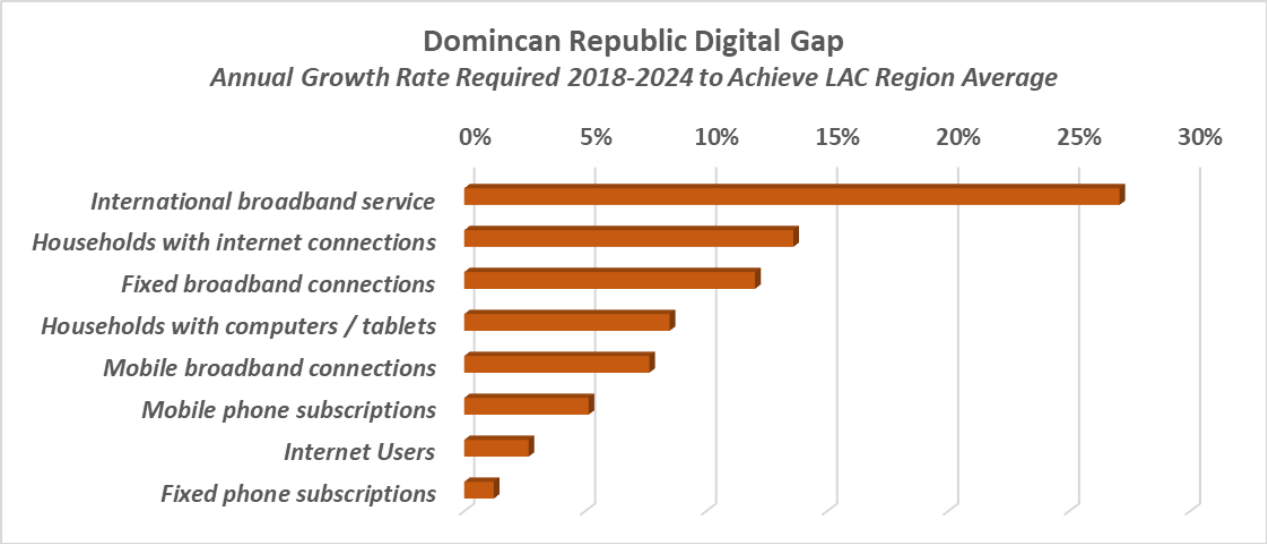
- Increase the level of connectivity and broadband access at affordable prices, and
- Enhance the capacity and quality of the country's international access.

One key motivating factor behind the National Broadband Plan is the "digital gap" in the Dominican Republic. The ICT national observatory ONTIC[16] has quantified the country's digital gap in terms of an annual growth rate required over the period of 2018 to 2024 for the Dominican Republic to achieve average LAC region benchmarks, as described in Figure 8. The current gap is greatest for international broadband service and the percentage of households with access to

[16] ONTIC – Observatorio Nacional de las Tecnologías de la Información y la Comunicación

internet connections. The gap is smaller for fixed telephone subscriptions and the percentage of the population who are internet users.

Figure 8: Dominican Republic Digital Gap



The National Broadband Plan also will support a digital transformation of the public sector, under which it will ensure that the entire population, regardless of geographic location, has access to quality and affordable digital technologies to promote improvements in:

- Education;
- Productivity;
- Economic growth;
- Health services;
- Citizen security and safety; and
- The exercise of freedom of expression.

The plan will contribute to achieving broader goals, including:

- Well-being;
- Sustainable development of society; and
- Reduction of poverty and inequality.

The plan calls for the regulator, INDOTEL[17], to fast-track the 5G auction for 2021. The tender process will involve allocating frequencies in the 700MHz band (703 to 748MHz and 758 to 803MHz, for a total of 90 MHz) and the 3.5GHz band (3300 to 3460MHz, for a total of 160 MHz).

[17] INDOTEL – Instituto Dominicano de Telecomunicaciones

INDOTEL published the tender conditions in Resolution 005-2021 on February 4, 2021. Nine 2×5MHz blocks of 700MHz spectrum will be made available, alongside 16x10MHz blocks of 3.5GHz spectrum. Licenses will be awarded for up to 20 years. Existing licensees may bid for the remaining time of their licenses. INDOTEL also proposes limitations on the combined bandwidth of all spectrum licenses for individual operators, as follows:

- Maximum of 70MHz under 1GHz; and
- Maximum of 100MHz between 3.3 and 3.6GHz.

The National Broadband Plan also contemplates digital terrestrial television (DTTV). The plan calls clearing the 700MHz band and calling for public entities to turn over rights to INDOTEL for frequencies between 500 and 806MHz. INDOTEL is expected to publish a roadmap for DTTV by the end of 2022.

To fast-track the nation's fiber-optic backbone network, the national power distributor ETED[18] will open its internal fiber-optic network to provide broadband services.

INDOTEL is developing the remaining elements of the National Broadband Plan through a roundtable process initiated in October 2020. Domestic participants in the roundtables include the:

- Vice Ministry of Digital Agenda, Ministry of the Presidency;
- Vice Ministry of Innovation and Technology, Ministry of Public Administration;
- Vice Ministry of Planning and Public Investment, Ministry of Economy, Planning, and Development;
- Presidential Office of Information and Communication Technologies;
- Ministry of Education;
- Ministry of Industry and Commerce;
- Ministry of Energy and Mines; and
- ETED.

International participation in the roundtable process includes the:

- United Nations Development Program (UNDP);
- Inter-American Development Bank (IADB); and
- Alliance for Affordable Internet (A4AI).

PROJECT STATUS AND IMPLEMENTATION TIMELINE

In December 2020, INDOTEL published the calendar for the 5G auction shown in Table 9.

[18] ETED – Empresa de Transmisión Eléctrica Dominicana

Table 9: Dominican Republic 5G Auction Calendar

Date, 2021	Milestone
February 9	Commencement of tendering process
May 17	Deadline for bidders to register and request questions/clarifications
June 4	Deadline to respond to bidders request
July 14	Deadline to submit offers
August 10	Deadline to submit corrections
August 25	Results of administrative offers
September 13	Opening of economic offers and selection of winning bidders
November	Contract signing upon receiving stipulated guarantees

The other remaining elements of the National Broadband Plan require further investigation and consensus. The roundtable process began in October 2020 and is still underway.

PROJECT COST AND FINANCING

The roundtable process to develop the National Broadband Plan is expected to produce an initial budget estimate for implementation.

The Dominican Republic expects the 5G tender to yield approximately $300 million in concession fees[19]. The tender resolution requires that offerors present an investment plan but does not provide an estimate of the amount of investments required in 5G infrastructure.

U.S. EXPORT OPPORTUNITIES

In addition to competing for spectrum licenses, Dominican Republic National Broadband Plan export opportunities for U.S. companies include:

- Fiber optic network backhaul hardware, software, and installation and maintenance services;
- Small- and pico-cell, low-power base station hardware, software, and installation and maintenance services;
- Multiple-input/multiple-output (MIMO) technology, antenna modules, and installation, maintenance, and advisory services;
- Beamforming technology and advisory services;
- DTTV signal transmission and network equipment;
- Centralized radio network (C-RAN) technology, baseband unit hardware and software, and advisory services; and
- Giga-bit WiFi technology, hardware, software, and advisory services.

[19] As announced by the President of INDOTEL on November 27, 2020 when interviewed by AcentoTV.

CONTACTS

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5 El Salvador

5.1 ICT Demographics

El Salvador is the smallest Central American nation by land mass and the only one without a Caribbean Sea coastline. The country borders Guatemala and Honduras. El Salvador is characterized by its mountainous terrain, a central plateau, and a thin coastal area. The country's landmass is 20,721 square kilometers, about the same as the U.S. state of New Jersey in size. Nearly 75 percent of its land is agricultural.

Known as the Land of Volcanoes, El Salvador is subject to frequent volcanic activity and earthquakes. Also, the country is highly susceptible to hurricanes.

El Salvador is home to 6.5 million people, the most densely populated Latin American country. Population density is high across the country, with particular concentration around the capital city, San Salvador.

5.2 ICT Sector Development

As measured by telephone, internet, and fixed broadband access, El Salvador's existing ICT sector is below world averages. However, per capita mobile telephone subscriptions are among the highest in the sub-region. El Salvador is 83rd and 88th in the world in terms of total fixed broadband and mobile cellular subscriptions, respectively, while it stands at 105th and 20th globally on a population-adjusted basis[20].

El Salvador ranks 138th globally in terms of the percentage of its population with access to the internet. In 2018, approximately 34 percent of the population had internet access[21].

Urban populations comprise more than 73 percent of ICT infrastructure users in El Salvador.

Today, El Salvador has no subsea telecommunication cable landing points. The country does not own any satellites.

5.3 Regulatory Landscape

The Superintendencia General de Electricidad y Telecomunicaciones (SIGET) is the telecommunications regulating agency in El Salvador. Products using radio frequency, cellular, or satellite technologies require approval and certification for commercialization in El Salvador, including RFID, WiFi, Bluetooth, Zigbee (personal area networks/IoT), and wireless gateways.

Numerous privately-owned national terrestrial television networks and cable TV networks providing international content service El Salvador. The government owns one radio station

[20] International Telecommunications Union
[21] World Bank

alongside hundreds of commercial radio broadcasters. The transition to digital transmission began in 2018 using the Japanese-Brazilian Digital Standard, ISDB-T.

5.4 ICT Sectors Profiled

This Resource Guide reviews four development projects in El Salvador in the following sectors:

- *Smart Cities and e-Government:* El Salvador has begun select smart cities initiatives, although the country is constrained at present by its cellular infrastructure and broadband availability. The capital city, San Salvador, has embarked on a "Smart City" plan involving two digital platforms: an Intelligent Operations Center (CIO) with state-of-the-art cameras; and a Smart 912 application to update citizen reports in real-time, launched in 2018. The nationwide Digital Agenda reviewed following, outlines plans for national e-Government. A plan for smart street lighting and video surveillance on all roads and highways is also reviewed.
- *Internet of Things (IoT) and Artificial Intelligence (AI):* Due to current constraints in El Salvador's cellular infrastructure, the country is early in adopting IoT and AI applications. IoT technology has been used for mudslide warnings, and efforts with telehealth have begun in conjunction with the COVID-19 global pandemic. Two IoT/AI projects are reviewed following: one for enhancing operations and safety at El Salvador's single international airport and the second for providing partial seaport automation at Acajutla Port.

5.5 Projects Profiled

Four El Salvador ICT projects are profiled as described in Table 10:

Table 10: ICT Development Projects – El Salvador

Project	Sponsor
El Salvador Digital Agenda	Secretaría de Innovación de la Presidencia
Highway Lighting PPP Pipeline in El Salvador	Organismo Promotor de Exportaciones e Inversiones de El Salvador (PROESA)
International Airport ICT Upgrade	San Óscar Arnulfo Romero y Galdámez International Airport (AEIS-SOARG)
Semi-Automation of Containers at Acajutla Port	Comisión Ejecutiva Portuaria Autónoma (CEPA)

El Salvador Digital Agenda	
SUBSECTOR	**Smart Cities and e-Government**
LOCATION	**El Salvador**
PROJECT VALUE	**>$65 million**

PROJECT SUMMARY

- The Salvadoran Digital Agenda will integrate the actions of all of the actors in the ICT space as an essential part of the country's economic and social development.
- The project comprises four components:
  - Digital Identity;
  - Innovation, Education, and Competitiveness;
  - Modernization of the State; and
  - Digital Governance.
- The project duration is ten years.
- Sponsor funding is $6.5 million annually; additional financing sources are expected.

PROJECT BACKGROUND AND DESCRIPTION

The Salvadoran Digital Agenda aims to encourage and integrate the actions of all of the actors in the ICT space as an essential part of the country's development. The project builds on the country's historical ICT development context, including:

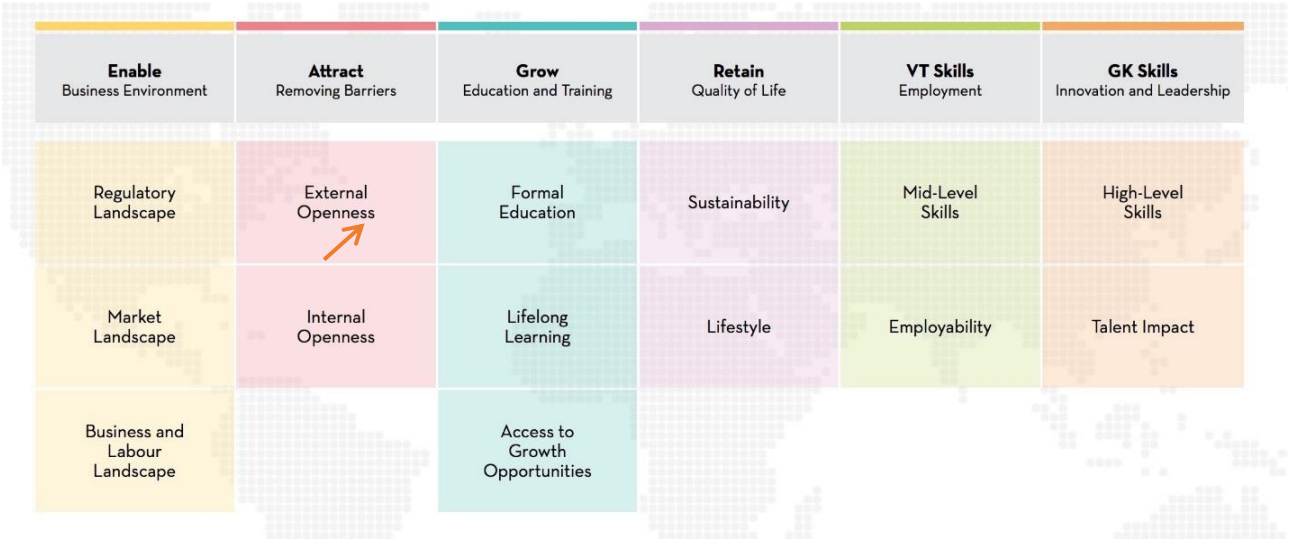
- 2000: National IT Policy;
- 2005: e-Country Program;
- 2010: Creation of the Directorate for Technological Innovation and IT; and
- 2019: Creation of the Secretariat for Innovation.

The Salvadoran Secretary for Innovation will oversee the implementation of the Digital Agenda. The Secretary cites the Global Talent Competitiveness Index (GTCI) as a key impetus for the Project[22]. The GTCI is a composite index (Figure 9), relying on a simple but robust Input-Output model, composed of six pillars (four on the input side and two on the output side). The four pillars on the input side focus on actions for policymakers and business leaders: enable, attract, grow and retain. The two pillars on the output side benchmark national performance: technical/vocational and global knowledge skills.

In 2020, El Salvador was ranked 110 out of 132 countries evaluated for the index. The Secretary for Innovation concludes that "without any doubt, we must change."

[22] https://gtcistudy.com/#

Figure 9: 2020 GTCI Ranking Methodology



Key benefits of the project implementation are expected to include:

- Social well-being;
- Security; and
- Economic development.

The Digital Agenda comprises four components:

Component 1 - Digital Identity
Component 1 will create a suite of technological solutions for the management of personal data, the secure exchange of information, and the integration of digital services using a single national identity, including:

- A National Registry of Families, upgrading the National Registry of Natural Persons;
- A National Digital Identity, including electronic signature services; and
- Citizen Focus, consolidating and streamlining services provided to citizens.

Component 2 - Innovation, Education, and Competitiveness
Component 2 will create a multi-sector integration system to boost technology education, competitiveness, and access to broadband services. This Component also includes mechanisms to promote entrepreneurship through an innovation ecosystem, trade supported by ICT solutions, and improved employability through enhanced knowledge management to reduce the digital divide.

Component 2 comprises seven lines of action:

1. ***Innovation*** – Research and development of technologies that will contribute to the fourth industrial revolution;
2. ***Connectivity, Coverage, and Access*** - Design and deployment of telecommunications network infrastructure to connect the entire country to deliver digital public services, which in turn will foster the development of e-commerce and a knowledge-based economy;

3. ***Public Servant Capabilities*** - Training programs to strengthen the capacities and skills of public servants to deliver high quality, user-focused digital services;
4. ***Smart Cities*** - Promoting the use of technologies that facilitate daily urban life;
5. ***Education and Literacy in Technology*** - Training programs for the general public to take advantage of new digital services, reduce the digital divide, and meet market demands in the new digital economy;
6. ***Fintech*** - Promoting innovation of financial products and services focused on facilitating business and government procedures, as well as financial inclusion, including an electronic payment system; and
7. ***Digital Inclusion*** - Promoting technology access and use as a tool for pursuing social and economic welfare.

Component 3 - Modernization of the State

Component 3 will integrate and modernize State services, guarantee citizen participation and transparency, strengthen administrative records, and safeguard access to personal data. This Component comprises four lines of action:

1. ***Document Automation*** - Actions to replace physical documents with electronic documents, including high impact projects such as the Electronic Invoice;
2. ***Administrative Records*** - Adoption of standards for the digitization of Executive Branch records, data exchange through the National Interoperability Platform, and publication of open and up-to-date statistical data;
3. ***Modernization of Services*** - Application of the Government's digital services architecture to strategic sectors and services, adhering to international standards. Implementation of a single portal for all public services; and
4. ***Transparency and Open Data*** - Generation of data sets in open formats for public access and the publication of informal information in all state institutions.

Component 4 - Digital Governance

Component 4 will create a favorable legal framework, facilitating the construction of an information and knowledge society that includes the entire population, protects rights, and guarantees privacy and security on the internet, including:

- ***Enabling Laws*** - A new regulatory framework that facilitates collaboration between different public institutions, allows exchange and protection of data, eliminates bureaucratic barriers, strengthens the economy, and provides document automation, guaranteeing the rights of all actors in the digital environment;
- ***Cybersecurity*** - Regulations and guidelines for the prevention, detection, and remediation of possible technological vulnerabilities to protect the critical national infrastructure; and
- ***Environmental Protection*** - Technological and innovative measures to protect the environment, encourage the production and consumption of renewable energy, and regulate the management of technological waste.

PROJECT STATUS AND IMPLEMENTATION TIMELINE

Key project milestones include:

- A 10-year time horizon, through 2030;
- Launch in a public meeting on January 15, 2020
- Featured as the main program of the Secretariat of Innovation on June 1, 2020.

Each activity under each project Component will have its own implementation timeline.

PROJECT COST AND FINANCING

The annual budget for the Secretariat of Innovation is $6.5 million. Since the Digital Agenda is its main program, we estimate the Sponsor's contributions to be $65 million over ten years.

The Secretariat of Innovation plans on involving different actors in implementing the Digital Agenda, including academia, NGOs, private companies, entrepreneurs, international financial institutions (IFIs) including the World Bank and the Inter-American Development Bank, technology companies, and all public sector entities. Therefore, the overall budget will be considerably higher than the Sponsor's contribution.

U.S. EXPORT OPPORTUNITIES

Export opportunities for U.S. companies for El Salvador's Digital Agenda include:

- Digital identity solutions:
  - National registries;
  - Digital identity;
- Fiber optic network hardware and spares;
- Network and location system hardware and software;
- Training programs:
  - Public servants;
  - General public;
- Advisory services:
  - ICT design and development services and consulting;
  - Networking design, implementation, and security;
  - Application design, development, testing, and implementation;
  - Custom programming; and
  - Legal and policy advisory services.

CONTACTS

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Highway Lighting PPP Pipeline in El Salvador	
SUBSECTOR	**Smart Cities and e-Government**
LOCATION	**El Salvador**
PROJECT VALUE	**$60 million**

PROJECT SUMMARY

- This project, in three phases, will install smart street lighting and video surveillance equipment on over 700 km of roads and highway structures.
- The project will be implemented as three different public-private partnerships (PPPs) by the Organismo Promotor de Exportaciones e Inversiones de El Salvador (the Exports and Investment Promotion Agency of El Salvador, or PROESA).

PROJECT BACKGROUND AND DESCRIPTION

The Overseas Security Advisory Council[23] observes that road lighting is generally non-existent on roads and highways outside urbanized areas in El Salvador. Stray animals, unwary pedestrians and bicyclists, and numerous large potholes (or missing manhole covers) make driving particularly dangerous and hazardous at night. In addition, the lack of road lighting and cameras fosters criminal activity on unlit roads.

The Ministry of Public Works has established three objectives for this project:

1. Increase road safety;
2. Reduce the likelihood of nightly accidents from lack of lighting; and
3. Reduce vandalism to public and private property.

The project's objective, over three phases, is to install smart street lighting and video surveillance equipment on over 700 km of roads and highways, as shown in Figure 10.

Phase I includes the following routes along 143 km of road, as shown in Figure 11:

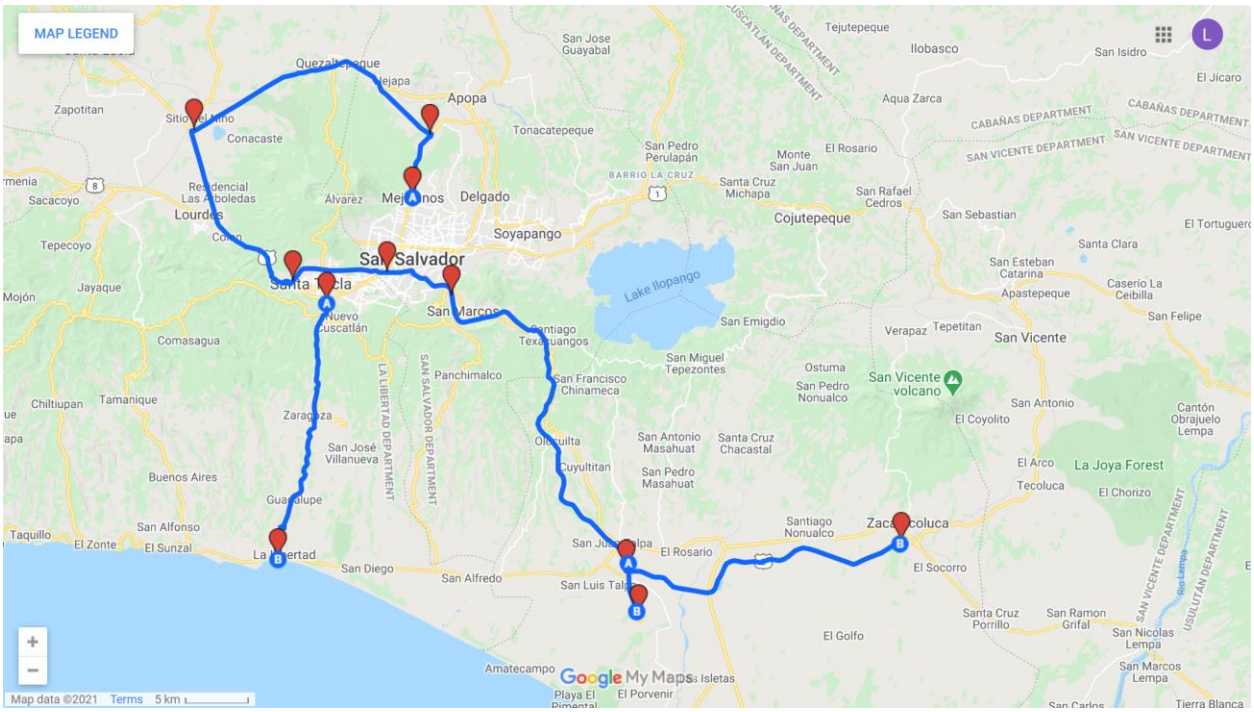
- Bulevar Constitución (SAL37);
- Integration Round - Quezaltepeque (RN07);
- Opico Detour – Lourdes (CA01);
- Boulevard Monsignor Romero (RN21);
- Boulevard Los Próceres;
- Highway to Comalapa (RN05);

[23] Bureau of Diplomatic Security, U.S. Department of State

- El Salvador International Airport Monsignor Oscar Arnulfo Romero and Galdámez;
- Sections of the Highway to Comalapa – Zacatecoluca; and
- Road to the Port of La Libertad.

Figure 10: Illuminated Highway Displayed in the Phase I Tender Announcement

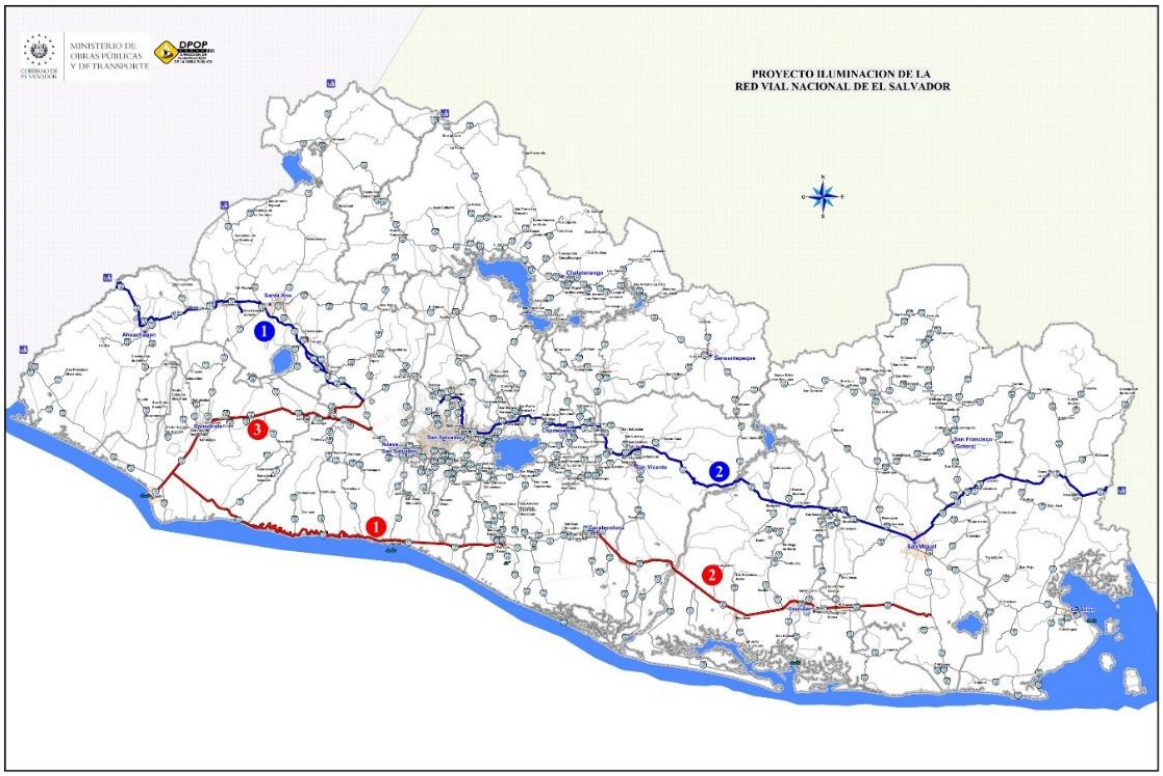
Figure 11: Map of Phase I Illumination Route



Phases II and III, as shown in Figure 12, include:

- Phase II:
  - Route 1: CA02 Littoral Sections: CA12S (Dv. Port of Acajutla) – RN05S (Dv. El Salvador Airport);
  - Route 2: Tramo Zacatecoluca (CA02E) - El Delirio (RN 17S); and
  - Route 3: Acajutla Stretch (CA12S) - Lourdes (CA8).
- Phase III:
  - Route 1: Las Chinamas Border Route (CA08W) - Opico Detour; and
  - Route 2: Redondel Integration Section (SAL38W) - Frontera El Amatillo.

Figure 12: Map of Illumination Routes for Phases II and III



The project will be implemented as three different public-private partnerships (PPPs) by PROESA. Private sector partners will have investment obligations in exchange for receiving the rights to develop certain commercial activities along the routes. Revenues for the private sector partners may come from various sources, including:

- Outdoor advertising;
- Land use charges;
- Fiberoptic network development; and
- Underground pipelines.

PROJECT STATUS AND IMPLEMENTATION TIMELINE

Phase I was initiated in 2015, with PROESA approving the Phase I feasibility study in September 2018. The Ministry of Public Works announced the Phase I tender in January 2020. The original deadline for bidders to respond to the Phase I tender was June 2020. The tender schedule has been protracted due to the COVID-19 global pandemic. PROESA has communicated a new deadline during the first half of 2021 to potential offerors who purchased the tender package.

Phases II and III are at the feasibility study stage. PROESA will prepare tender packages for these phases once the feasibility studies are finalized and approved.

PROJECT COST AND FINANCING

The estimated cost for Phase I is $12.3 million. PROESA will oversee the preparation of cost estimates for Phases II and III during the ongoing feasibility studies. Using the same unit cost for Phase I of $86,000 per kilometer, we estimate the future phase costs to be approximately:

- Phase II - $23.6 million for 274 km; and
- Phase III - $24.5 million for 285 km.

The estimated combined cost for the three phases is approximately $60.4 million.

Project preparation for Phase I was financed by FOMILENIO II, a program financed with $277 million through the Millennium Challenge Corporation and an $88.2 million contribution from the government of El Salvador. FOMILENIO II was active in supporting the entire pipeline of PPP projects in El Salvador. The program was finalized on September 8, 2020.

U.S. EXPORT OPPORTUNITIES

A variety of export opportunities exist for U.S. companies with respect to project implementation:

- Smart street lighting components and solutions:
    - ICT hardware - smart poles and sensors;
    - LED bulbs;
    - ICT software, including IoT apps; and
    - Control center design and equipment.

- Video surveillance components and solutions:
    - ICT hardware – cameras and sensors;
    - ICT software – apps and systems operation;
    - Control center design and equipment; and
    - Consulting – training and certification.

CONTACTS

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International Airport ICT Upgrade	
SUBSECTOR	**Internet of Things (IoT) and Artificial Intelligence (AI)**
LOCATION	**San Óscar Arnulfo Romero y Galdámez International Airport**
PROJECT VALUE	**$18 million**

PROJECT SUMMARY

This project will implement six ICT upgrades to El Salvador's San Óscar Arnulfo Romero y Galdámez International Airport (AEIS-SOARG)[24]:

- An automatic system of immigration control doors;
- Meteorological Doppler radar;
- An aeronautic meteorological system;
- An intelligent perimetral monitoring system;
- A common-use passenger processing system; and
- A facial recognition system.

The project duration is approximately three years.

PROJECT BACKGROUND AND DESCRIPTION

In 2019, AEIS-SOARG handled 2.46 million passengers and 25,865 metric tons of cargo from over 100,000 aircraft operations. Prior to the COVID-19 global pandemic, passenger throughput at the airport was growing at ten percent annually. AEIS-SOARG is El Salvador's single commercial airport. The main terminal building is illustrated in Figure 13.

The airport ICT upgrade project includes six components:

Component 1: Automatic System of Immigration Control Doors
The implementation of this project will allow a smooth flow of passengers through the airport's immigration control, avoiding the long lines while maintaining control of the people who may or may not enter the country and focusing manual control only on the people of interest.

Component 1 includes development and installation of:

- Four modular control corridors;
- A video surveillance system and infrared sensors;
- A flow control system;

[24] Referred to as AIES-SOARG from its Spanish acronym

- An intercom system;
- A biometric control system;
- A passport reader system;
- A passport stamping system;
- A central control system;
- A data network; and
- An uninterruptible power supply (UPS) system.

This component also includes operational and technical training for all systems.

Figure 13: San Óscar Arnulfo Romero y Galdámez International Airport

Implementation will be an inter-institutional project between the airport and the Directorate-General for Migration and Foreign Affairs, coordinated by both parties.

Component 2: Meteorological Doppler Radar

Doppler radar will be used for atmospheric monitoring and protection of aeronautical operations in the airspace controlled by the airport. The use of Doppler radar will increase the operational safety of air navigation in El Salvador, contributing to more precise and reliable forecasts and warnings of weather phenomena that may affect commercial aviation.

Doppler radar will be used to locate precipitation, calculate its trajectories, and estimate its forms (rain, snow, hail, et al.) Three-dimensional data can be analyzed to extract storm structures as well

as potential trajectories and damage. The radar also detects the presence of birds in the airspace that may be a danger to aviation.

The Doppler radar shall consist of the following elements:

- An antenna tower;
- A dome;
- A shed;
- A UPS;
- Dual transmitters and receivers;
- Local and remote servers;
- Data links;
- User workstations; and
- Components for integrating data to the radar control system.

Component 3: Aeronautic Meteorological System
The current meteorological system has been in service for ten years. It requires frequent corrective maintenance, and some spare parts are no longer readily available.

Component 3 includes the replacement, supply, installation, and integration of the following three systems:

- The automated weather observing system (AWOS);
- The low-level wind shear alert system (LLWAS); and
- The automatic terminal information system (ATIS).

The AWOS provides local weather information. It consists of two weather stations, one at each head of the runway. The AWOS includes the following sensors:

- Wind direction and speed;
- Barometric pressure;
- Temperature;
- Relative humidity;
- Present time;
- Dew point;
- Precipitation;
- Visual range on track;
- Electric storm detection;
- Ceilometer; and
- Solar radiation.

The LLWAS develops forecasts and early warnings for low-level wind shear. The system includes:

- An ultrasonic wind sensor;
- A radio modem; and

- A solar panel with a battery.

The ATIS provides aircraft with local weather information and any other airfield information of interest to crews. The system includes:

- A communications server;
- VHF radio for continuous voice and data transmission; and
- Interconnection with AWOS servers.

Component 4: Intelligent Perimetral Monitoring System
The El Salvador International Airport has a longitudinal perimeter of 10 km to protect the aeronautical area. At present, the perimeter is being partially protected and monitored by means of CCTV and a face-to-face security system.

Component 4 envisions installing an intelligent electronic perimeter security system to protect the airport facility periphery through automated perimeter breach monitoring, control, and detection. Via the security operations center (SOC), incidents can be monitored, recognized, and identified remotely and efficiently.

The Intelligent Perimetral Monitoring System will include the following elements:

- A smart perimeter fence;
- CCTV cameras;
- Long-distance thermal motion cameras;
- Motion detection radars;
- Microphoned fiber optic cables;
- Solar panels with batteries; and
- A datalink.

Component 5: Common-Use Passenger Processing Systems (CUPPS)
A CUPPS will facilitate the sharing of check-in and gate counters for existing airlines and support new airlines. The system will offer more efficient use of the available space for passenger processing. In addition, it will reduce passenger processing time.

Key elements of the CUPPS include:

- Passport readers;
- Payment terminals;
- Boarding pass printers;
- Baggage tag generation;
- A datalink;
- Servers; and
- Communication components.

The CUPPS will be fully compliant with the specifications contained in IATA (International Air Transport Association) document PSCRM-RP1797. Additional features of the system will include:

- Real-time monitoring and reporting of passenger processing;
- Reduction in the installation costs and airport time to add new airlines;
- Optimum distribution of check-in desks and boarding gates for any airline;
- A common, multi-access platform for the use of all airlines; and
- Higher reliability compared to individual airline passenger processing systems.

Component 6: Facial Recognition System

Currently, El Salvador International Airport does not have a facial recognition system. The objective of this project component will be the implementation of a biometric recognition system based on facial features. Facial recognition is one of the least invasive biometric solutions, as data is effortlessly captured and generally does not involve user interaction.

The facial recognition system will include the following elements:

- Facial recognition cameras;
- A license to activate the facial recognition module;
- Image recognition hardware;
- Communication devices;
- Data links;
- A database; and
- Software licenses.

The system will also integrate databases from different national and international organizations to ensure that facial recognition cameras can automatically identify a person or group of persons who are of "interest" to the authorities.

PROJECT STATUS AND IMPLEMENTATION TIMELINE

The implementation time for each project component is described in Table 11:

Table 11: San Óscar Arnulfo Romero y Galdámez International Airport Upgrades Time Requirements

Project Component		Timeline, months
1	Automatic System of Immigration Control Doors	12
2	Meteorological Doppler Radar	18
3	Aeronautic Meteorological System	18
4	Intelligent Perimetral Monitoring System	12
5	Common Use Passenger Processing System	12
6	Facial Recognition System	12

PROJECT COST AND FINANCING

The budget breakdown by project component is provided in Table 12:

Table 12: San Óscar Arnulfo Romero y Galdámez International Airport Upgrades Budget

Project Component		Budget, $million
1	Automatic System of Immigration Control Doors 12m	1.5
2	Meteorological Doppler Radar 18m	6.0
3	Aeronautic Meteorological System 18m	3.0
4	Intelligent Perimetral Monitoring System 12m	1.6
5	Common Use Passenger Processing System 12m	5.0
6	Facial Recognition System 12m	0.6
Total Budget		***17.7***

AIES-SOARG is seeking funding sources for project implementation.

U.S. EXPORT OPPORTUNITIES

Export opportunities for U.S. companies in conjunction with the AIES-SOARG ICT upgrades are likely to include:

- Specialized airport and navigation hardware and equipment:
  - Modular control corridors;
  - A passport reader and stamping system;
  - Doppler radar;
  - Meteorological instruments;
  - VHF radio; and
  - Boarding pass and baggage tag printers.
- Surveillance hardware and systems:
  - A video surveillance system;
  - A biometric control system;
  - A smart perimeter fence;
  - CCTV cameras;
  - Long-distance thermal motion cameras;
  - Motion detection radars; and
  - Facial recognition cameras.
- Common ICT system components:
  - Central control systems;
  - Data networks;
  - Local and remote servers;
  - User workstations; and
  - UPS systems.
- Design and engineering services for airport and navigation solutions:

- An automatic system of immigration control doors;
- Meteorological doppler radar;
- An automated weather observing system;
- A low-level wind shear alert system;
- An automatic terminal information system;
- An intelligent perimetral monitoring system;
- A common use passenger processing system; and
- A facial recognition system.

CONTACTS

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Semi-Automation of Containers at Acajutla Port	
SUBSECTOR	**Internet of Things (IoT) and Artificial Intelligence (AI)**
LOCATION	**Acajutla Port, Sonsonate, El Salvador**
PROJECT VALUE	**$4 million**

PROJECT SUMMARY

- This project will semi-automate the container terminal operations at El Salvador's largest seaport:
  - All flows of information will be automated; however
  - Gantry cranes will continue to be operated manually.
- Project implementation will commence with a detailed engineering study followed by a pilot phase.

PROJECT BACKGROUND AND DESCRIPTION

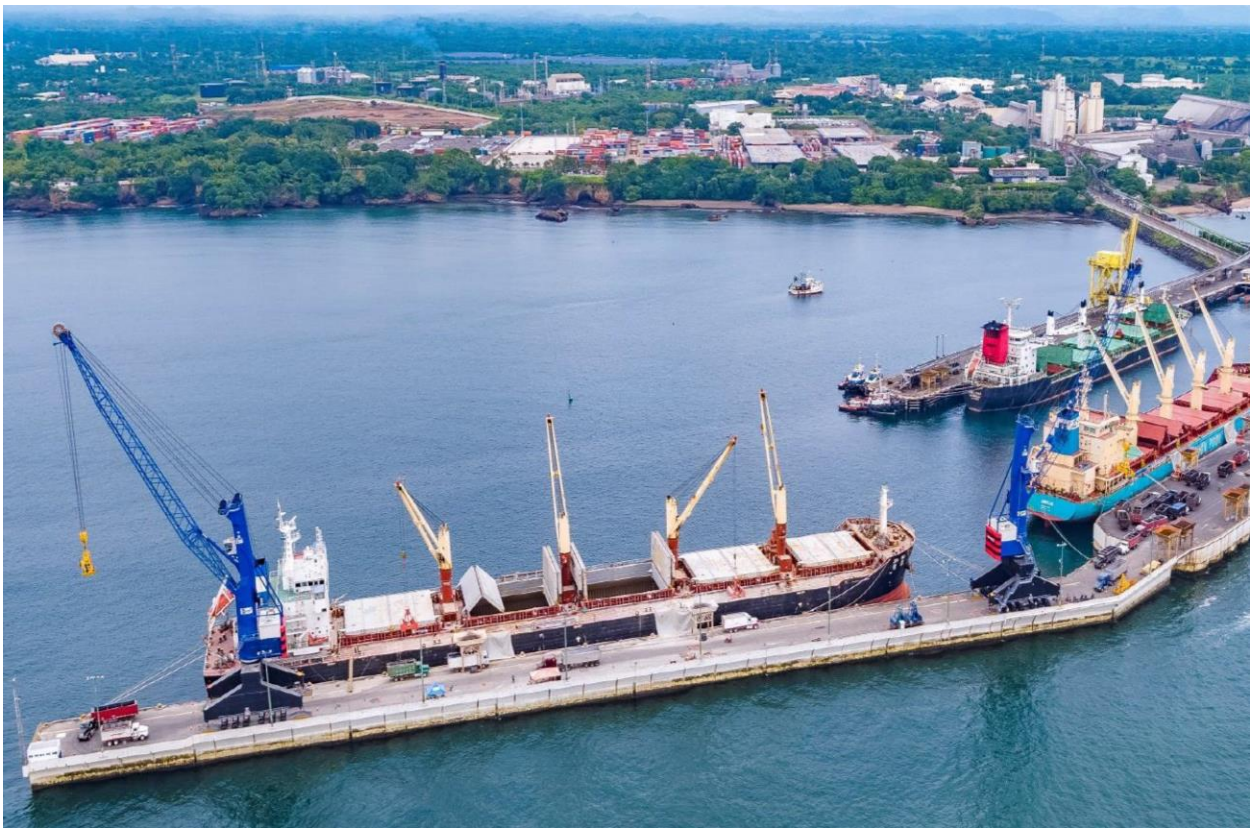
The Port of Acajutla was designed as a multipurpose port and began operations in 1961. Currently, the port channels 99.7 percent of the flow of El Salvador's foreign trade by sea. Typical of those operating with bulk cargo, the port has an offshore design with the docks separated from the coastline to take advantage of greater natural water depths. The wharves are connected to the shore for vehicle transit and bulk cargo transit via conveyor belt.

The port has three wharves:

- Wharf A, operational since 1961, with a length of 300m;
- Wharf B, located inside of Wharf A, operational since 1970, with lengths of 328m for the southern berth and 345m for the northern berth; and
- Wharf C, operational since 1975 as an extension to Wharf A, with a length of 270m.

The working depths of Wharves A and B range from 9.0 to 10.7m. Wharf C has a working depth of 12m. Recently, Wharf C was fitted with post-Panamax class ship-to-shore (STS) cranes, as shown in Figure 14.

Figure 14: Wharves at Port Acajutla with Post Panamax STS Cranes



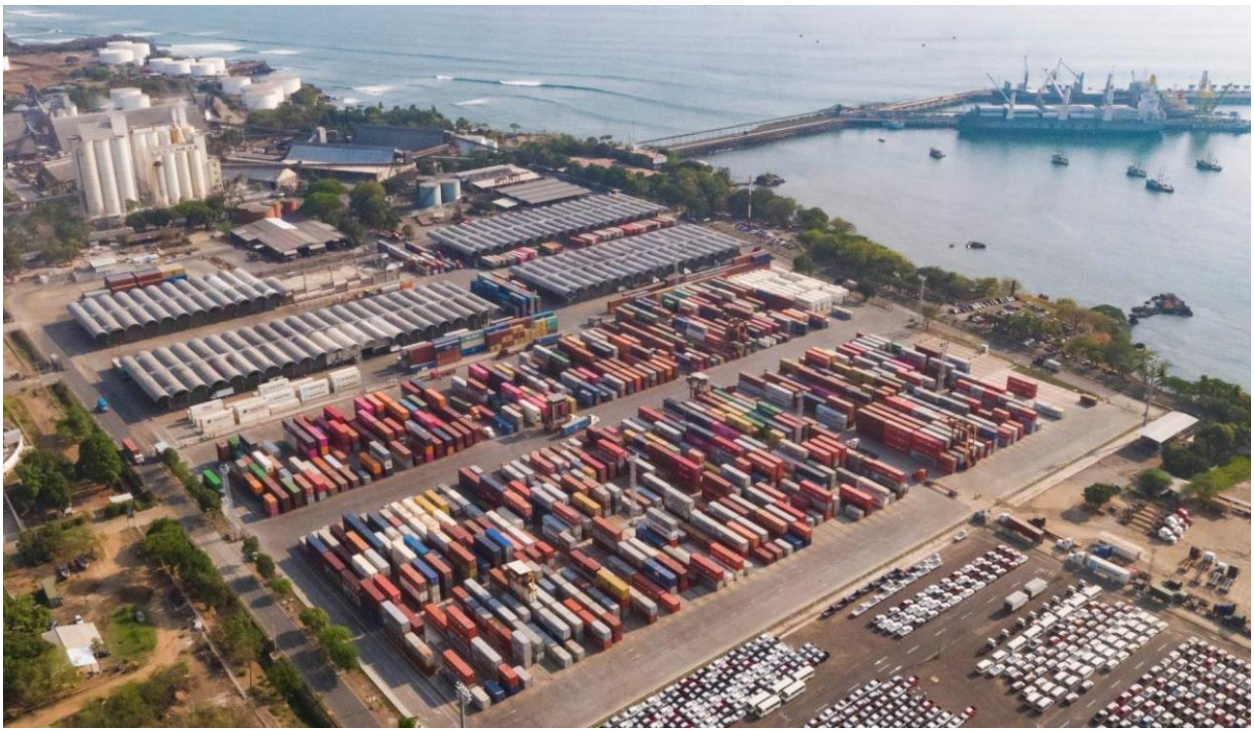
The Port of Acajutla handles containers, bulk liquids, bulk solids, vehicles, and passengers. Total shipments in 2019 exceeded five million metric tons, as summarized in Table 13:

Table 13: 2019 Movements at Port of Acajutla

Cargo Type	*Total (kt)*	*Ship Type*	*Number*
General	416	General Cargo	121
Containerized	2,043	Container	244
Bulk Solid	2,375	Bulk Cargo	138
Bulk Liquid	603	Tanker	67
Total	***5,437***	Multipurpose	10
		Total	***580***

The objective of this project is to semi-automate container handling in the port, with the port's container terminal shown for reference in Figure 15.

Figure 15: Container Terminal at Port Acajutla



Benefits from project implementation are expected to include:

- Reducing human error and container handling delays;
- Ensuring 24/7 service availability;
- Increasing productivity;
- Reducing operating expenses;
- Facilitating green economy transactions;
- Increasing transparency and communication between stakeholders;
- Enhancing operational, managerial, and commercial decision-making; and
- Increasing the country's logistical competitiveness.

When the project is implemented, the gantry cranes to manage containers will continue to be operated manually, but all information flows will be automated. Key steps for project implementation include:

1. Redesigning the current operating model;
2. Organizing the terminal with a first-in, first-out model;
3. Simplifying all processes;
4. Applying standardized processes integrated with private and public actors;
5. Considering integration with multimodal transport;
6. Providing dispatching for scheduled appointments;
7. Locating containers in real-time, accurately;
8. Tracking operations and containers in real-time;

9. Automating data management and transmission;
10. Interconnecting all machinery and equipment operating in the yard with the terminal management technology;
11. Ensuring the flow of operations information is fully automated from yard to dock;
12. Integrating dock operations, crane movement, and revenue and output control (flow) of all storage areas and access doors;
13. Using ICT intensively to predict and forecast demand for port operations and to adjust logistics in real-time;
14. Using environmentally friendly technology;
15. Introducing artificial intelligence to predict and forecast the demand for port operations;
16. Designing strategies for preventive and strategic equipment maintenance;
17. Developing simulation tools for the operational planning of the terminal;
18. Designing contingency plans and exception handling;
19. Designing a strategic plan for implementation; and
20. Including a pilot plan for the gradual implementation of the new operating model.

PROJECT STATUS AND IMPLEMENTATION TIMELINE

The port is managed by the Comisión Ejecutiva Portuaria Autónoma (CEPA), a public sector entity. CEPA is preparing the terms of reference for the engineering design study. Key elements of the implementation timeline include:

- Execution of the Engineering design study;
- Development of the Pilot implementation plan;
- Design and installation of a wireless network for the container terminal;
- Roll out of new project systems;
- Operator training; and
- Acquisition of new straddle carriers.

PROJECT COST AND FINANCING

The sponsors estimate a project implementation budget of $4 million and are exploring bilateral funding mechanisms to implement the project.

U.S. EXPORT OPPORTUNITIES

U.S. technology company capabilities align well with likely Acajutla Port needs under its automation project. Export opportunities will include:

- Port-specific application and AI tool and software development;
- Internet of Things (IoT) applications for container monitoring;
- Cameras and video content analytics;

- Network hardware, devices, software, and services including:
  - Connectivity hardware and cabling;
  - Control and network management systems;
  - Network management software and cybersecurity; and
  - Management, qualification, and training services.

CONTACTS

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6 Grenada

6.1 ICT Demographics

Grenada is an island nation between the Caribbean Sea and the Atlantic Ocean. The country sits north of Trinidad and Tobago. Grenada is characterized by its mountainous terrain, a central plateau, and a thin coastal area. The country's landmass is 344 square kilometers, about twice the size of Washington, D.C. Roughly 50 percent of Grenada's land is forest, with another 32 percent agricultural.

The country lies in the hurricane belt. Two volcanoes, Mount Saint Catherine, the island's highest point, and Kick 'em Jenny, an active submarine volcano, which lies about 8 km north of the island, present additional ICT infrastructure risks.

One of the smallest global countries in terms of population, Grenada is home to just under 155,000 people. Approximately one-third of the population lives in the capital city region of St. George. The balance of the island's population is concentrated along its coast.

6.2 ICT Sector Development

As measured by telephone, internet, and fixed broadband access, Grenada's existing ICT sector is below world averages. However, per capita mobile telephone subscriptions are among the highest in the sub-region. Grenada is 146th and 181st in the world in terms of total fixed broadband and mobile cellular subscriptions, respectively, due to its small population. On a population-adjusted basis, the country stands at 63rd for fixed broadband and 115th for mobile cellular subscriptions globally[25].

Grenada ranks 97th globally in terms of the percentage of its population with access to the internet. In 2018, approximately 59 percent of the population had internet access[26].

Urban populations comprise only about 36.5 percent of ICT infrastructure users in Grenada.

Grenada has subsea fiber optic cable access to the following:

- The 3,000 km Southern Caribbean Fiber, with landing points on 14 islands, including Grenada. This cable lands at Port Salines in Grenada.
- The 1,730 km Eastern Caribbean Fiber System (ECFS) cable connecting 10 Eastern Caribbean nations. The cable lands at Port Salines, Grenada.
- The 775 km X-Link Submarine Cable connecting Barbados, Grenada, Guyana, and Suriname. This cable also lands in Grenada at Port Salines.
- The 225 km Caribbean Regional Communications Infrastructure Program (CARCIP) cable connects Grenada with St. Vincent and the Grenadines. This cable has two landing points in Grenada (Carriacou and Conference) and seven in St. Vincent and the Grenadines.

[25] International Telecommunications Union
[26] World Bank

The country does not own any satellites.

6.3 Regulatory Landscape

Grenada established the National Telecommunications Regulatory Commission (NTRC) in 2000 to regulate its telecommunications market in collaboration with the Eastern Caribbean Telecommunications Authority. The agency's mission is to regulate the telecommunications sector to ensure fair, competitive practices by providers and to promote and maintain high-quality services at fair and competitive prices for consumers.

Multiple publicly and privately-owned television and radio stations exist in Grenada. Grenada Information Service (GIS) is a government-owned provider of television and radio services. The Grenada Broadcasting Network, jointly owned by the government and the Caribbean Communications Network of Trinidad and Tobago, operates a TV station and two radio stations. Another approximately 25 private radio stations serving the island. For television, a local media company, Moving Target, broadcasts television island-wide and also provides an FM radio station and a weekly newspaper. Cable television service is available.

6.4 ICT Sectors Profiled

This Resource Guide reviews one Smart City and e-Government development project in Grenada. Grenada is undertaking a plan for digital governance with a specific view to enhancing ICT capabilities, increasing the use of digital technologies in government, including payment systems, and strengthening institutions to manage change. The country has also been working with the Marron Institute of Urban Management at New York University (NYU) to establish Grenada as the first Climate Smart City. This effort has identified nine projects to improve the lives of Grenadians, several of which have ICT components.

6.5 Projects Profiled

One ICT project in Grenada is profiled as described in Table 14:

Table 14: ICT Development Project -- Grenada

Project	Sponsor
Grenada Digital Government for Resilience	Ministry of Infrastructure Development, Public Utilities, Energy, Transport and Implementation (MOIID)

Grenada Digital Government for Resilience	
SUBSECTOR	**Smart Cities and e-Government**
LOCATION	**Grenada**
PROJECT VALUE	**$15 million**

PROJECT SUMMARY

- The Grenada Digital Government for Resilience Project will enhance the efficiency, usage, and resilience of two government digital services:
  - Reducing the time spent on tax-related transactions; and
  - Streamlining transactions through a new civil registry system.
- The project comprises three components:
  - Developing the enabling environment;
  - Levering digital technologies; and
  - Strengthening institutions and managing change.
- The project is entirely funded by an International Development Association (IDA) grant.

PROJECT BACKGROUND AND DESCRIPTION

Grenada is a small island economy in the eastern Caribbean with approximately 114,000 inhabitants. Like many other island nations in the region, the country is highly susceptible to natural disasters, especially hurricanes, and its economy is highly dependent on tourism.

The impacts of Hurricane Ivan on Grenada in 2004 were devastating. The storm damaged nearly 90 percent of the housing stock. Total losses were valued at twice the country's GDP. Poverty increased considerably in the aftermath of the storm.

Grenada joined the Caribbean Regional Communications Infrastructure Program (CARCIP) in 2012. CARCIP was a World Bank-funded program to build the physical infrastructure to support the development of digital economies in St. Lucia, Grenada, and St. Vincent and the Grenadines. CARCIP incrementally expanded access to ICT across the country by providing fiber optic connectivity to government buildings, schools, health centers, police stations, and other selected users.

Existing government systems show opportunities for integration and streamlining:

- There are multiple identity systems for the births and deaths registry, the electoral card system, and the passport issuance platform – none of which interface with each other;
- Government payment receipts are not regularly accompanied by identification, which introduces the risk of money laundering; and

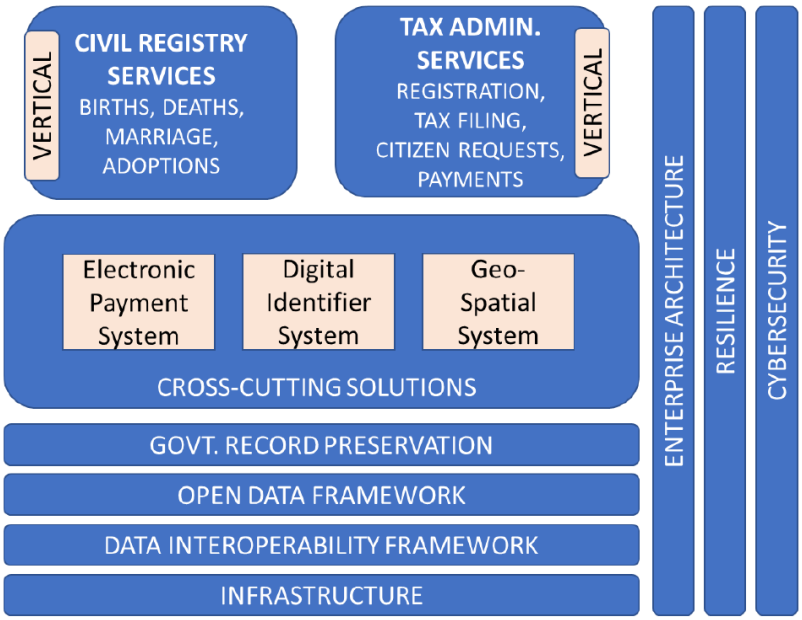
- Most payments for services, such as birth certificates, are made manually, take an average of two days to process, and require physical presence, putting those who live outside the capital city of St. George's at a significant disadvantage.

The World Bank project information document[27] concludes the public sector in Grenada is characterized by institutions operating in information silos with outdated IT infrastructure. Many administrative functions are constrained by their reliance on manual systems and weak information management. Systems, processes, and service delivery channels remain fragmented across individual agencies in the absence of institutional arrangements and integrated platforms to enable the workflow and exchange of information across public sector institutions.

The goal of Grenada's Digital Government for Resilience Project is to enhance the efficiency, usage, and resilience of selected government digital services. Specific objectives include reducing the time spent on tax-related transactions and streamlining transactions through a new civil registry system.

The Project defines resilience as business continuity in the aftermath of man-made or climate-induced disasters, cyberattacks, or other crises that might otherwise disrupt service delivery. Business continuity focuses on the preservation of critical government records and e-service functionality. A schematic logic diagram for project implementation is provided in Figure 16.

Figure 16: Grenada Digital Government for Resilience Project - Schematic Logic Diagram



[27] The World Bank. Grenada Digital Governance for Resilience. May 2019.

The Project comprises three components:

Component 1: Developing the Enabling Environment to Modernize Service Delivery

Component 1 will establish the technical, institutional, legal, and regulatory foundations to provide the enabling environment to enhance internal administrative efficiencies and collaboration across government entities. This component will support the design and implementation of a government-wide Enterprise Architecture (EA) and Interoperability Framework for deploying the cross-cutting platforms required to enable digital service delivery. The EA will focus on:

- Reviewing the legal and regulatory framework;
- Reengineering and streamlining key business processes to improve efficiency;
- Designing and introducing improvements to existing organizational structures, roles, and responsibilities;
- Developing institutional arrangements for managing digital government transformation; and
- Developing recommendations to enhance the post-technological implementation environment from the reforms.

Under this component, the project will deliver a document management system to register, archive, and preserve critical government records, including:

- Lands and deeds;
- Birth, death, and marriage certificates;
- Government contracts;
- Government directives;
- Intellectual property;
- Blueprints; and
- Judicial records.

Component 1 will also deliver three cross-cutting digital platforms:

1. An electronic payment system;
2. A single sign-on digital identifier platform; and
3. A Spatial Data Platform (SDP).

Component 2: Leveraging Digital Technologies to Deliver Selected Services

The objective of the second component is to enable the delivery of two high-priority public services through digital technologies:

1. The Civil Registry, where citizens can apply for birth, death, marriage, and adoption certificates and pay for them online or in-person; and
2. Tax Administration Services, where citizens can access core tax administration services and the government can perform core tax administrative processes in a digital environment accessible online, at kiosks, and in person.

The systems will be integrated with the digital identifier and electronic payment platforms developed under Component 1. The project will adopt a phased approach for rolling out the new tax administration services.

Component 3: Strengthening Institutions and Managing Change

The objective of the third component is to strengthen the institutional and human capacity to manage the digital government transformation. This component will finance activities to strengthen the public sector's technical and project management capacities to transition to a digital service delivery environment. Component 3 will also develop digital literacy and awareness in citizens and businesses to navigate the improvements introduced under the first two components. This component includes:

- *Capacity Building and Technical Advice*: long-term, on-the-ground capacity building and advisory support to strengthen the technical capacity of public entities in key aspects of digital government transformation and management;
- *Project Management*: day-to-day coordination and project management of the activities carried out under the project; and
- *Change Management*: development and implementation of a change management strategy to ensure project results are utilized effectively by the public sector, business, and citizens.

The Department of Implementation (DOI) of the Ministry of Infrastructure Development, Public Utilities, Energy, Transport and Implementation (MOIID) will be the implementing agency for the project, responsible for overall project management, implementation, and coordination.

PROJECT STATUS AND IMPLEMENTATION TIMELINE

Grenada signed the financing agreement for the project with the IDA on October 19, 2019. The project's target completion date is September 2024. The projected completion targets by fiscal year are described in Table 15.

Table 15: Grenada Digital Government for Resilience Project – Annual Completion Targets

Fiscal Year Ending June 30:	Yearly Completion	Cumulative Completion
2020	4.9%	4.9%
2021	7.7%	12.6%
2022	13.5%	26.1%
2023	22.7%	48.8%
2024	33.1%	81.9%
2025	18.1%	100.0%

The project will prepare annual operational plans and budgets specifying activities by project components and subcomponents. The COVID-19 global pandemic has hindered project initiation.

PROJECT COST AND FINANCING

The Grenada Digital Government for Resilience Project is financed under a $15 million grant provided by the IDA. The project will be financed entirely with IDA grant proceeds, without government of Granada counterpart funding. The budget breakdown by project component is provided in Table 16.

Table 16: Grenada Digital Government for Resilience Project – Project Component Budgets

Project Component	Budget, $million
1. Developing the Enabling Environment	5.90
Enterprise architecture and interoperability framework	*0.65*
Cloud-based and cyber-secure cross-cutting platform	*2.75*
Digitization of key government records	*2.50*
2. Leveraging Digital Technologies	5.00
New civil registry system	*1.00*
New core tax system	*4.00*
3. Strengthening Institutions and Managing Change	4.10
Project management and technical advisory	*3.10*
Implementation activities for citizens and businesses	*1.00*
Total Budget	***15.0***

U.S. EXPORT OPPORTUNITIES

U.S. company export opportunities for the Project include:

- Hardware:
  - Data center componentry (servers, racks, power, HVAC, site security, et al.); and
  - Digital operations center equipment (networking hardware, fiber optic cabling and components, power management hardware, et al.)
- Software:
  - Access to Software as a Service (SaaS) and related scalable programs;
  - Custom software/applications – civil registry and tax administration tools, as well as the electronic payment system; and
  - Cybersecurity solutions.
- Advisory services:
  - E-Government design and development services and consulting;
  - Networking design, implementation, and security; and
  - Application design, development, testing, and implementation.

CONTACTS

Project Sponsor	U.S. Trade and Development Agency	U.S. Commercial Service
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7 Guyana

7.1 ICT Demographics

Guyana is a northern South American country on the Atlantic Ocean, bordering Venezuela, Brazil, and Suriname. The country is characterized by rolling highlands and a low coastal plain. The southern portion of the country is savanna. Guyana's landmass is 196,849 square kilometers, slightly smaller than the size of the U.S. state of Idaho. Over 77 percent of Guyana's land is forest, including large, unspoiled rain forests. The country has a small percentage of agricultural land. Natural hazards are limited to occasional flash floods during the country's rainy season.

Guyana is home to just under 790,000 people. The country's population is concentrated around the capital city of Georgetown, the Berbice River to its east, and the northeastern area. The rest of the country has a limited population. Guyana is the only English-speaking South American country.

7.2 ICT Sector Development

As measured by telephone, internet, and fixed broadband access, Guyana's existing ICT sector is below-average globally. However, per capita mobile telephone subscriptions are among the highest in the sub-region. Guyana is 125th and 162nd in the world in terms of total fixed broadband and mobile cellular subscriptions, respectively, and 103rd for fixed broadband and 153rd for mobile cellular subscriptions globally, on a population-adjusted basis[28].

Guyana ranks 133rd globally in terms of the percentage of its population with access to the internet. In 2018, approximately 37 percent of the population had internet access[29].

Urban populations comprise only about 27 percent of ICT infrastructure users in Guyana.

Guyana has subsea fiber optic cable access to the following:

- The 1,249 km Suriname-Guyana Submarine Cable System (SG-SCS) connecting Suriname, Guyana, and Trinidad and Tobago. The cable lands in Guyana near the capital city of Georgetown.
- The 775 km X-Link Submarine Cable connecting Barbados, Grenada, Guyana, and Suriname. This cable also lands near Georgetown.

The country does not own any satellites.

[28] International Telecommunications Union
[29] World Bank

7.3 Regulatory Landscape

The Guyana Telecommunication Agency (GTA) is the principal telecommunications regulator in the country. In October 2020, the government gave a commencement order to fully implement the Telecommunications Act 2016 and the Public Utilities Commission Act 2016, which will effectively end the monopoly and allow for competition in key segments of the country's telecommunications sector, including fixed telephony and international voice and data transmission. The government has been conducting stakeholder meetings during late 2020 and early 2021.

At present, the government of Guyana largely controls the country's broadcast media. Guyana owns and operates two radio stations broadcasting on multiple frequencies capable of reaching the entire country and has limited licensing of private radio stations. The National Communications Network (NCN) TV is state-owned. A few private television stations provide satellite services.

The National Data Management Authority (NDMA) is charged with transforming the delivery of government services using the internet and other information and communication technologies (ICTs). NDMA holds the responsibility for Guyana's e-Government agenda and is working to ensure government ministries and agencies and Guyanese citizens can access public services online.

7.4 ICT Sector Profiled

This Resource Guide reviews one Smart City and e-Government development project in Guyana. The project, a roadmap for digital governance, is a key part of NDMA's mandate.

The country's President has stressed that "Guyana is becoming a digital state." In 2019, the $313 million Center for Excellence in Information Technology was commissioned as a joint initiative with India. The Center will provide training, including in network security, learning systems, administration, and networking. The government expects ICT deployment to improve productivity and competitiveness, thus triggering an economic transformation, a critical concern in a country where 20 percent of its population resides elsewhere.

7.5 Projects Profiled

One ICT project in Guyana is profiled as described in Table 17:

Table 17: ICT Development Project -- Guyana

Project	Sponsor
Guyana Digital Governance	National Data Management Authority (NDMA)

Guyana Digital Governance	
SUBSECTOR	**Smart Cities and e-Government**
LOCATION	**Guyana**
PROJECT VALUE	**$30 million**

PROJECT SUMMARY

- Guyana is implementing a long-term, digital governance roadmap covering five areas:
  - Governance;
  - Service-oriented government;
  - Flagship applications;
  - Infrastructure; and
  - Cybersecurity.
- The roadmap was developed with support from the Inter-American Development Bank (IADB).

PROJECT BACKGROUND AND DESCRIPTION

The long-term objectives of Guyana's e-Government program are twofold:

1. To enable equitable digital citizenship; and
2. To provide transparent, accountable, responsive, and efficient governance for all Guyanese.

From 2015 to 2018, Guyana focused on building an e-Government network to bridge the country's digital divide, particularly between coastal and inland and poor and affluent communities. Essential results of the effort were:

- Connecting Ministries and public entities via a secure, standards-based, national ICT platform; and
- Providing access to telecommunication networks and e-Services for citizens throughout the country.

In 2017, Guyana commenced stakeholder consultations to prepare a long-term national development strategy. In May 2019, the country published its Green State Development Strategy: Vision 2040, a twenty-year national development policy based on an overarching vision:

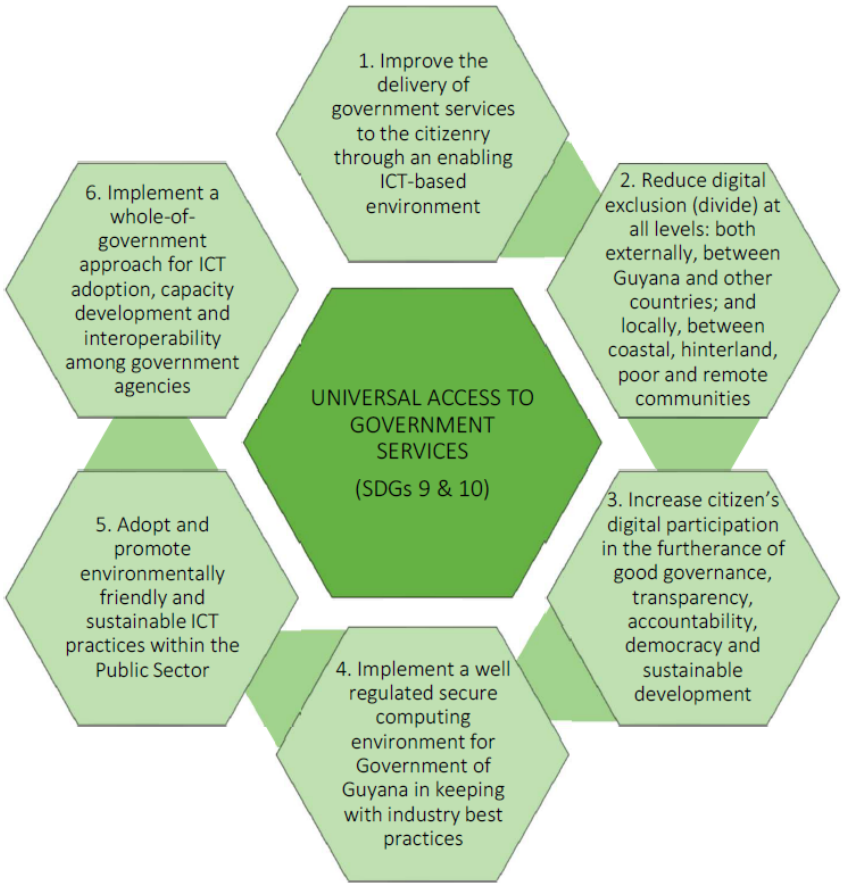
> *An inclusive and prosperous Guyana that provides a good quality of life for all its citizens based on sound education and social protection, low-carbon and resilient development, providing new economic opportunities, justice, and political empowerment.*

The Vision 2040 strategy includes two specific policy recommendations for telecommunication networks:

- Improve broadband access in the Hinterlands through a three-stage approach:
  - Build a national fiber-optic backbone to provide broadband access to the Hinterland and other remote communities;
  - Deploy the most appropriate backhaul (intermediate) and last-mile technology; and
  - Roll out Wi-Fi access technology.
- Ensure public buildings have broadband access and develop free-of-charge e-Government-services.

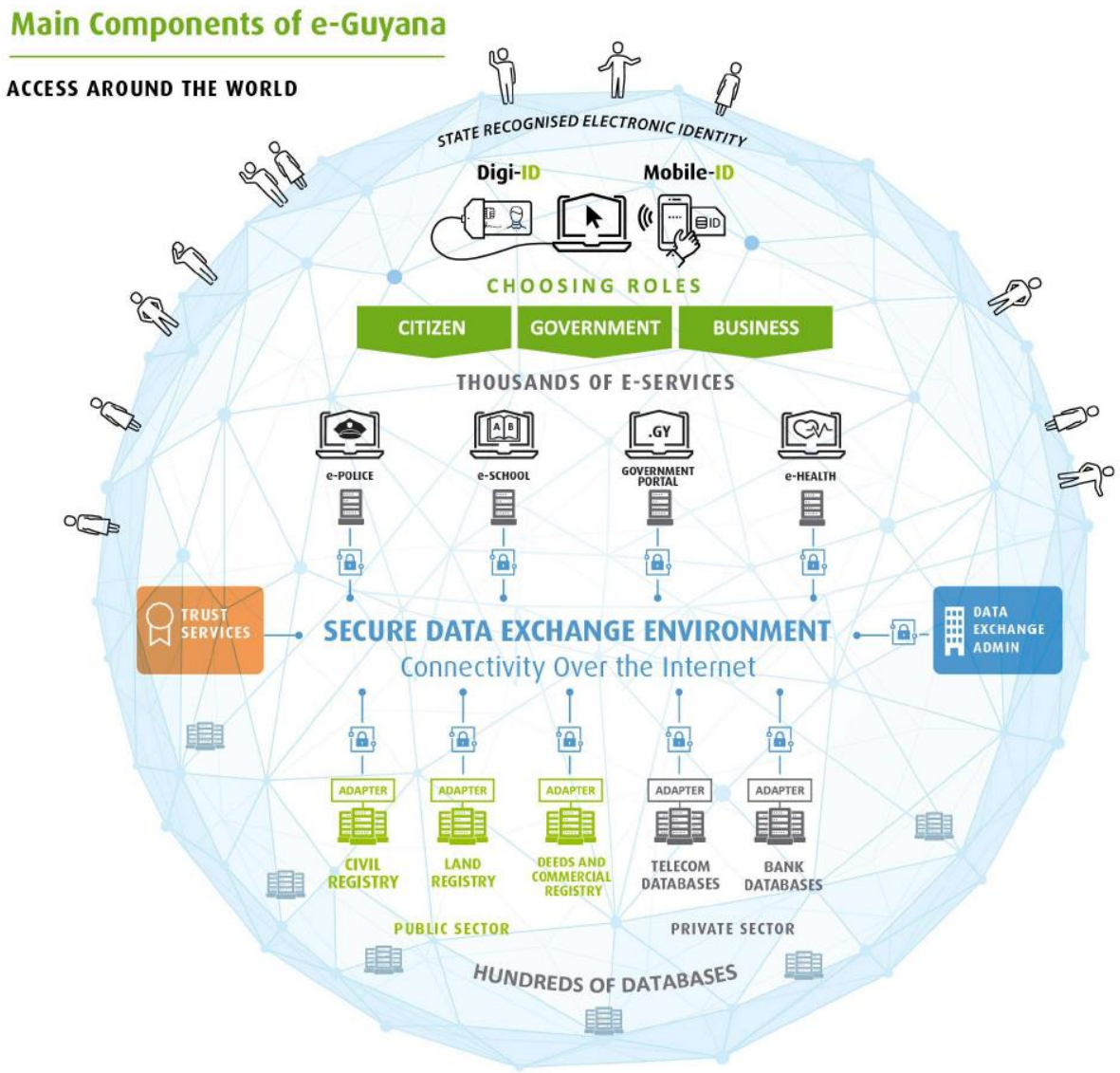
At the end of 2018, with support from the IADB, the government of Guyana developed and approved a long-term e-Government roadmap. The Cabinet approved the roadmap in December 2018 and named the National Data Management Authority (NDMA) as the lead coordinating agency. The strategic objectives of the roadmap are depicted in Figure 17.

Figure 17: Strategic Objectives of Digital Governance in Guyana



The principal components of digital governance in Guyana are described in Figure 18.

Figure 18: Main Components of Digital Governance in Guyana



Implementation of the Guyana roadmap emphasizes five key areas:

1. Governance:
   - Strengthen e-Government coordination by reinforcing the NDMA's role of e-Government Coordinator for Government of Guyana agencies with a focus on planning, budgeting, implementation, and monitoring of e-Government initiatives;
   - Harmonize legislation by reviewing existing legislation and implementing suggestions for e-Government related legislative changes, specifically the modernization of the NDMA Act (1983) and development of required legislation (e.g., Personal Data Protection, Electronic ID, Digital Signatures, Data Management); and
   - Harmonize e-Government development to avoid parallel investments. Implement a clearly defined e-Government budget in the state budget framework to mitigate duplication.

2. Service-Oriented Government:
    - Manage population and identity, specifically the implementation of electronic identification (e-ID) for all citizens and develop the necessary base registers (i.e., population, commercial, and real estate registers) and population management solution;
    - Create an enabling environment for e-Service delivery and implement an interoperability framework, specifically the completion of an inventory of databases and services, requisite data standards, and the implementation of the X-Road interoperability framework for secure data exchange; and
    - Assess digitization level and data quality and develop and implement a strategic plan to improve digitization and data quality.

3. Flagship Applications:
    - Develop an e-Cabinet solution;
    - Upgrade the citizen portal for information and e-Services;
    - Develop a national geoportal for Guyana;
    - Develop solutions for e-Health, e-School, and e-Police (beginning with the development of concept papers);
    - Develop e-Democracy and e-Participation solutions; and
    - Develop an open data portal for Guyana.

4. Infrastructure:
    - Implement a metadata management solution, including a catalog of interoperability solutions (CatIS);
    - Implement a secure data exchange-interoperability solution;
    - Implement Public Key Infrastructure (PKI) and Digital Identity packages;
    - Assess, plan, and implement connectivity and broadband access.

5. Cybersecurity:
    - Develop a national-level cybersecurity strategy and implementation plan;
    - Establish cybersecurity policy, coordination, threat assessment, and analysis units;
    - Standardize cyber and information security implementation, training, situation analysis, and develop requirements; and
    - Conduct regular cyber assessments/audits/tests and continuous monitoring.

PROJECT STATUS AND IMPLEMENTATION TIMELINE

The timeframe to implement the entire Guyana digital roadmap is approximately 15 years. Initial actions focus on a three-year implementation timeline, which the COVID-19 global pandemic has protracted. Initial implementation actions include piloting specific applications, such as:

- A CatIS metadata management instrument;
- An e-ID solution pilot; and
- The secure data exchange (X-Road) interoperability framework.

Implementation tasks with longer timeframes include:

- Building an open data ecosystem;
- Establishing a framework for spatial governance;
- Developing infrastructure for Guyanese e-ID and trust services;
- Developing e-Democracy and e-Participation in Guyana; and
- Creating national cybersecurity capacities.

PROJECT COST AND FINANCING

Currently, all government agencies develop their own IT budget estimates and feed these into the budget process coordinated by the Ministry of Finance. No central financial monitoring framework exists for e-Government projects.

Funding for ICT infrastructure in the Hinterland and rural areas is budgeted at $2 million for the fiscal year 2021. The digital governance roadmap does not include a total budget estimate. Based on historic ICT budgets, we estimate a capital expenditure of at least $30 million over the 15-year implementation timeframe.

The roadmap contemplates most of the e-Government-related developments will be implemented through projects funded by international donors. Separate financing mechanisms may be required to cover the operating costs of some investments.

U.S. EXPORT OPPORTUNITIES

U.S. export opportunities for the various e-Government initiatives in Guyana include:

- Hardware:
  - Data center componentry (servers, racks, power equipment, HVAC, etc.); and
  - Digital operations center equipment (networking hardware, fiber optic cabling and components, power management hardware, etc.)
- Software:
  - Access to Software as a Service (SaaS) and related scalable programs;
  - Custom software/applications including e-Cabinet, e-Services, e-Health, e-School, e-Police, e-Democracy, and e-Participation; and
  - Cybersecurity solutions.
- Advisory services:
  - ICT design and development services and consulting;
  - Networking design, implementation, and security;
  - Application design, development, testing, and implementation;
  - Custom programming;
  - Civil servant and operator training; and
  - Legal and policy advisory services.

CONTACTS

Project Sponsor	U.S. Trade and Development Agency	U.S. Commercial Service
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8 Haiti

8.1 ICT Demographics

Haiti is a Caribbean island nation sharing the Island of Hispaniola with the Dominican Republic. Haiti occupies the western third of the island and sits between the Caribbean Sea and the North Atlantic Ocean. The country features rough, elevated terrain and is the most mountainous in the region. The southern portion of the country is savanna. Haiti's landmass is 27,560 square kilometers, slightly smaller than the U.S. State of Maryland. Over two-thirds of Haiti's land is agricultural. Natural hazards include frequent hurricanes and occasional flooding, and earthquakes.

Haiti is home to approximately 11.2 million people. The country's population is concentrated near the coastal areas. French is the official language. About one-quarter of the population lives in the capital city of Port-au-Prince.

8.2 ICT Sector Development

Haiti's existing ICT sector is below world averages as measured by telephone, internet, and fixed broadband access. However, per capita mobile telephone subscriptions are among the highest in the sub-region. The country ranks 138th and 111th in the world in terms of total fixed broadband and mobile cellular subscriptions, respectively, and 157th for fixed broadband and 173rd for mobile cellular subscriptions globally, on a population-adjusted basis[30].

Haiti ranks 140th globally in terms of the percentage of its population with access to the internet. In 2018, approximately 32.5 percent of the population had internet access[31]. Urban populations comprise about 57 percent of ICT infrastructure users in Haiti.

Haiti has subsea fiber optic cable access to the following:

- The 2,817 km Bahamas Domestic Submarine Network (BDSNi), connecting 14 Bahamian cities and Haiti via a landing point near Port-au-Prince.
- The 1,000 km Fibralink Cable connecting the Dominican Republic, Jamaica, and Haiti. The Haitian Fibralink landing point is near Kaliko.

The country does not own any satellites.

8.3 Regulatory Landscape

Conseil National des Telecommunications (CONATEL) is the principal telecommunications regulator in Haiti. Haiti CONATEL oversees legislation and management of telecommunications, including:

[30] International Telecommunications Union
[31] World Bank

- Radio;
- Television;
- Telephone lines; and
- The internet.

CONATEL also provides licenses for internet access and supports pilot projects to improve internet access in Haitian:

- Telemedicine;
- Schools;
- Tele-education; and
- Community internet cafes.

Much of the broadcast media in Haiti operates within the private sector; only some companies are licensed. Nearly 100 television stations are available in Haiti, with only one owned by the government. The national government also owns one radio station. Approximately 100 community radio stations also operate. The balance of the roughly 800 radio stations in the country comprises about 55 percent licensed and 45 percent unlicensed stations.

8.4 ICT Sectors Profiled

This Resource Guide reviews one combination Terrestrial Communications Network Infrastructure: Telephone, Internet, and Broadband and Smart Cities and e-Government development project in Haiti. Telecommunications infrastructure requires further development to bring Haiti to competitive levels regionally and globally. During 2020, the nation expanded some of its LTE mobile telephone capabilities. The country's Digital Acceleration Project profiled following, which aims to provide improved digital infrastructure, broadband access, and emergency response.

The COVID-19 global pandemic has stressed the nation, with telehealth services limited on the island.

8.5 Projects Profiled

One ICT project in Haiti is profiled, as described in Table 18:

Table 18: ICT Development Project -- Haiti

Project	Sponsor
Haiti Digital Acceleration Project	Ministère des Travaux Publics, Transports et Communications (Ministry of Public Works, Transportation, and Communication (MTPTC))

Haiti Digital Acceleration Project	
SUBSECTOR	**Terrestrial Communications Network Infrastructure: Telephone, Internet, and Broadband** **Smart Cities and e-Government**
LOCATION	**Haiti**
PROJECT VALUE	**$60 million**

PROJECT SUMMARY

- The Digital Acceleration Project will increase access to broadband services and improve digital resilience to respond to shocks throughout Haiti.
- The project comprises four components:
  1. Enabling Environment of Digital Infrastructure and Services;
  2. Broadband Connectivity;
  3. Project Management and Implementation; and
  4. Contingent Emergency Response.
- The project's duration is six years. The World Bank is funding the effort with a $60 million grant.

PROJECT BACKGROUND AND DESCRIPTION

Existing mobile broadband networks cover a high percentage of the Haitian population, yet broadband service penetration is still rather limited. The current coverage of the mobile broadband 3G and 4G networks reaches approximately 83 and 43 percent of the population, respectively, as shown in Figure 19. Nonetheless, the actual penetration of Haitian broadband services reached only about 35 percent of the population in the first quarter of 2020, substantially less than the Latin America and Caribbean (LAC) average of 78 percent.[32]

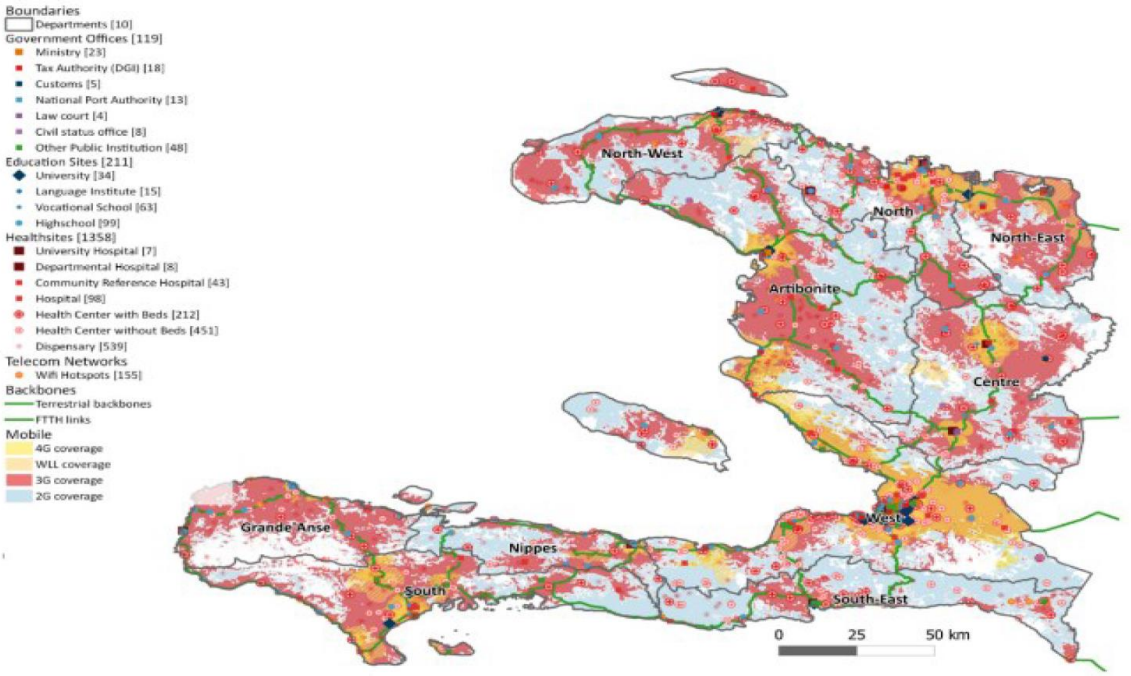
The affordability of Haitian broadband services is a significant barrier to their adoption by individuals and households. Mobile broadband costs US$2.74 for 1 Gigabyte (GB) per month on average. A 1 GB mobile broadband subscription at that pricing level represents 4 percent of the Gross National Income (GNI) per capita in Haiti, much higher than the average of 0.4 percent for LAC countries generally.

Broadband quality of service, equity in access, and speed are also areas of concern. Download speeds available through mobile and fixed networks are significantly lower in Haiti than in other LAC countries. High-speed and quality broadband services are available only to large users.

[32] World Bank Project Appraisal Document PAD3745. September 18, 2020.

Many businesses rely on satellites and wireless technologies, which are more resilient in restoring connectivity after natural disasters but are unduly expensive for individual usage.

Figure 19: Coverage of Mobile Broadband Networks in Haiti



Source: CONATEL and operators' data

The objectives of the Haiti Digital Acceleration Project are twofold:

- Increase access to broadband services in Haiti; and
- Establish the foundations of digital resilience to respond to shocks.

The project will support CONATEL[33] in developing and implementing International Telecommunication Union (ITU) guidelines for shock resilience of digital infrastructure.

The project comprises four components:

Component 1: Enabling Environment of Digital Infrastructure and Services

Component 1 focuses on developing the digital enabling environment through two subcomponents:

[33] CONATEL – Conseil National de Télécommunications, National Telecommunications Commission

Subcomponent 1.1: Supporting the Development of a Competitive Digital Infrastructure and Services Market

Subcomponent 1.1 includes support to CONATEL, MTPTC[34] , and other key stakeholders to:

- Develop sectoral strategies and studies;
- Strengthen technical, monitoring, and regulatory capacities; and
- Procure the necessary equipment to oversee developments in the sector.

Key activities of this subcomponent include:

- A digital economy assessment;
- Developing data governance and cybersecurity strategies and capacity building;
- Acquiring climate and disaster response management applications; and
- Developing regulatory equipment, strategies, and capacity building.

Subcomponent 1.2: Strengthening Digital Skills

Subcomponent 1.2 will finance digital skills programs tailored to the needs of various groups of beneficiaries by supporting the following activities:

- National Digital Skills Framework and Action Plan;
- Digital skills programs:
  - General population;
  - Female beneficiaries;
  - Public sector employees;
  - Health and education workers; and
  - Trainers and students.

Component 2: Broadband Connectivity

Component 2 focuses on enhancing broadband connectivity through two subcomponents:

Subcomponent 2.1: Supporting Access to Broadband Services to Key Public Service Beneficiary Institutions and the General Public

Under Subcomponent 2.1, the government of Haiti will purchase broadband services from private operators for key public sector institutions and several public Wi-Fi hotspots across the country. This approach will increase access and usage of broadband services over ten years. Although the existing infrastructure covers a large percentage of the population, usage remains low due to the inability of people, businesses, and the public sector to pay for broadband subscriptions on a permanent basis. Subcomponent 2.1 will consider the following:

[34] MTPTC - Ministère des Travaux Publics, Transports et Communications, Ministry of Public Works, Transportation, and Communication

- *Beneficiary Institutions*: 1,300 priority sites in all ten departments of the country, targeting local and central administration and key health and education sites, in addition to 155 Wi-Fi hotspots across the country, allowing the public access to enhanced and new broadband connectivity;
- *Coverage*: Existing networks cover 86 percent of the sites; the rest will require network upgrade or extension;
- *Contract details*: finance broadband services provided by telecom operators and ISPs to host institutions and beneficiaries for about ten years;
- *Private sector investment*: provide operators with secure anchor users for a considerable period, allowing them to invest in network extension and upgrade; and
- *Monitoring*: finance the services of an independent ICT supervision and monitoring firm to evaluate compliance with service-level agreements, as well as quality and technology standards.

Subcomponent 2.2: Enhancing the Key Public Service Beneficiary Institutions' Networking Services Capability

Subcomponent 2.2 will finance the modernization and digitization of specific government services, including:

- Enhancing the capabilities of health facilities to collect and exchange information within the different decision-making layers;
- Using internal networks and equipment to share content at universities and higher educational institutions;
- Purchasing dedicated network services to connect and maintain global wide area networks (GWANs) to interconnect public sector buildings and institutions around the country; and
- Financing end-user equipment (e.g., internet protocol (IP) telephony, communications rooms, and secure servers) and software, as well as reliable energy sources to operate basic IT equipment.

Component 3: Project Management and Implementation

UCE[35] will manage the project, and the MTPTC will host it. Component 3 will support the UCE in the management and implementation of the project, including:

- Capacity building;
- Training program design and execution;
- Procurement of goods; and
- External support from expert consultants and firms for:
  - Project management;
  - ICT technical advisory and implementation support;
  - Fiduciary, environment and social safeguards;
  - Monitoring and evaluation;
  - Citizen engagement tools; and
  - Strategic communications and awareness-raising.

[35] UCE - Unité Centrale d'Exécution des Projets, The Central Project Execution Unit

Component 4: Contingent Emergency Response

Component 4, an emergency component, will anticipate needs in the event of climate or natural disasters and public health emergencies due to Haiti's high risk of such shocks.

PROJECT STATUS AND IMPLEMENTATION TIMELINE

The government of Haiti signed the financing agreement for the project with the World Bank Group on October 28, 2020. The project's target completion date is December 2026. The projected completion targets by fiscal year are described in Table 19.

Table 19: Haiti Digital Acceleration Project Annual Completion Targets

Fiscal Year Ending June 30:	Yearly Completion	Cumulative Completion
2021	10.1%	10.1%
2022	13.3%	23.4%
2023	12.3%	35.7%
2024	13.2%	48.9%
2025	20.3%	69.1%
2026	21.4%	90.5%
2027	9.5%	100.0%

The project staff will prepare annual operational plans and budgets specifying activities by project components and subcomponents.

PROJECT COST AND FINANCING

The IDA (International Development Association, World Bank Group) has financed the Haiti Digital Acceleration Project under a $60 million grant provided. The budget breakdown by project component is described in Table 20.

Table 20: Haiti Digital Acceleration Project Budget

Project Component			Budget, $million
1	Enabling Environment of Digital Infrastructure and Services		12.0
	1.1	Competitive Market Development	6.0
	1.2	Digital Skills	6.0
2	Broadband Connectivity		44.0
	2.1	Public Sector Broadband Access	34.0
	2.2	Enhanced Public Sector Networking	10.0
3	Project Management and Implementation		4.0
4	Contingent Emergency Response		not valued
Total Budget			**60.0**

The project will be financed entirely with IDA grant proceeds, without government of Haiti counterpart funding.

U.S. EXPORT OPPORTUNITIES

Investment opportunities for U.S. suppliers for the Haiti Digital Acceleration Project include:

- End-user equipment:
  - IP telephony;
  - Communications rooms;
  - Secure servers; and
  - Reliable energy sources;
- E-Government software solutions;
- Advisory Services:
  - Market development;
  - Digital skills training programs; and
  - Project management.

CONTACTS

Project Sponsor	U.S. Trade and Development Agency	U.S. Commercial Service
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9 Honduras

9.1 ICT Demographics

Honduras is a coastal Central American nation, bordering the Caribbean Sea between Guatemala and Nicaragua and the Gulf of Fonseca (North Pacific Ocean) between El Salvador and Nicaragua. The Honduran landmass is 111,890 square kilometers, slightly larger than the U.S. state of Tennessee in size. About 45 and 29 percent, respectively, of Honduran land, is forest and agricultural.

Natural hazards include frequent hurricanes and flooding along the Caribbean coast, although some of the coastal shoreline is uninhabited.

Honduras is home to 9.3 million people. The population is concentrated in the western, mountainous region of the country. Tegucigalpa (1.5 million) and San Pedro Sula (929,000) split the country's urban population. The only densely populated lowland area is the Rio Ulua valley in the Honduran north.

9.2 ICT Sector Development

The Honduran ICT sector is below the world averages as measured by telephone, internet, and fixed broadband access. However, per capita mobile telephone subscriptions are among the highest in the sub-region. Honduras ranks 92nd and 98th in the world in terms of total fixed broadband and mobile cellular subscriptions, respectively, and 122nd for fixed broadband and 156th for mobile cellular subscriptions globally, on a population-adjusted basis[36].

Honduras ranks 141st globally in terms of the percentage of its population with access to the internet. In 2018, approximately 32 percent of the population had internet access[37].

Urban populations comprise just over 58 percent of ICT infrastructure users in Honduras.

The country has subsea fiber optic cable access to the 8,600 km ARCOS cable, connecting the Bahamas, Belize, Colombia, Costa Rica, the Dominican Republic, Guatemala, Mexico, Nicaragua, Panama, Turks, and Caicos, and the United States. The ARCOS cable lands near two Honduran cities, Puerto Cortes and Puerto Lempira.

Honduras does not own any satellites.

9.3 Regulatory Landscape

The National Telecommunications Commission (Comisión Nacional de Telecomunicaciones or CONATEL) regulates the telecommunications sector in Honduras. CONATEL promotes the modernization of telecommunications equipment, private investment, and free and fair

[36] International Telecommunications Union
[37] World Bank

competition. Wireless products and equipment connecting to the public switched telephone network (PSTN), along with other radio frequency equipment, require approval and certification by CONATEL, including:

- Private branch exchange (PBX) equipment;
- Routers, modems, and gateways;
- Cellular phones; and
- RFID and Bluetooth units.

Most broadcast media in Honduras resides in the private sector. Numerous terrestrial television stations are available and are supplemented by multiple cable television networks. Approximately 300 privately-held radio stations operate in the country. Radio Honduras is the sole government-owned radio network. Honduran schools provide free access to the internet.

9.4 ICT Sector Profiled

This Resource Guide reviews one development project in Honduras in the Smart Cities and e-Government sector. San Pedro Sula, as profiled following, is taking steps to become a recognized Central American smart city. In Tegucigalpa, private developers have undertaken a smart, mixed-use development focused on innovation and job creation. Its features include turnkey smart solutions, security, energy independence, redundant connectivity structure, sustainable site development, and a commercial "free zone." On the island of Roatán, a private economic development hub will enable Honduran and global businesses to create and grow ventures in education, healthcare, tourism, aquaculture, and other industries. The hub will diversify the local economy, develop job skills, increase foreign direct investment, and create opportunities for commercial growth.

9.5 Projects Profiled

One Honduras ICT project is profiled following (Table 21):

Table 21: ICT Development Project -- Honduras

Project	Sponsor
San Pedro Sula Technology District and Smart City Pilot	Alcdaldía de San Pedro Sula (Mayor's Office of San Pedro Sula)

San Pedro Sula Technology District and Smart City Pilot	
SUBSECTOR	**Terrestrial Communications Infrastructure: Telephone, Internet, and Broadband** **Data centers and Cloud Computing** **Smart Cities and e-Government**
LOCATION	**San Pedro Sula, Honduras**
PROJECT VALUE	**$19 Million**

PROJECT SUMMARY

- The San Pedro Sula Technology District, more formally the District of Technology, Culture, and Opportunities (DTCO), is an ambitious urban regeneration project on a prior correctional facility site.
- The district will develop 32 million square meters of municipal land in two phases, featuring:
  - Fiber optic broadband connections;
  - A highly reliable power supply;
  - A data center;
  - A smart city control center; and
  - A 5G pilot rollout.
- Phase I implementation is supported by an $11 million loan from the Inter-American Development Bank (IADB).

PROJECT BACKGROUND AND DESCRIPTION

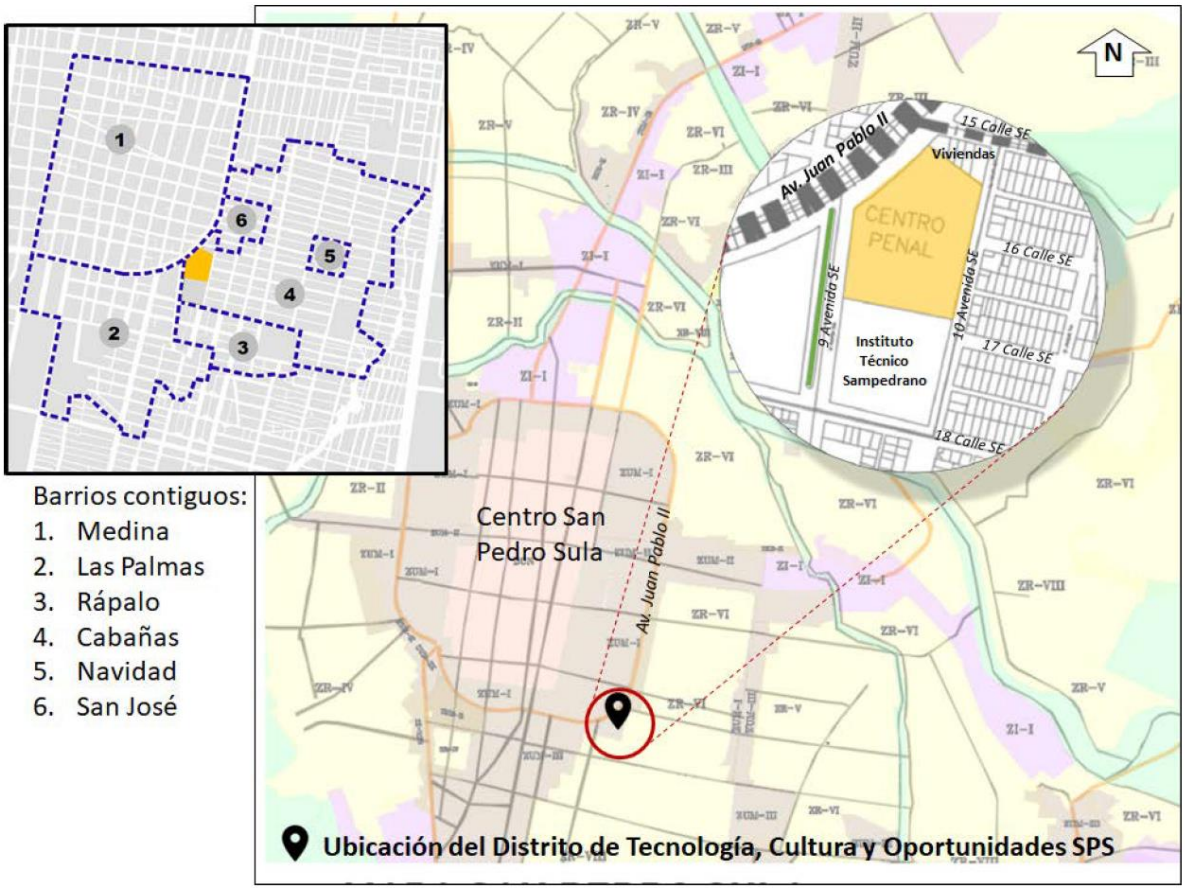
San Pedro Sula is Honduras's industrial center and second-largest city, with a metropolitan area population of nearly 1.5 million. The city is the capital of the Cortés Department. Much of San Pedro Sula's growth as an industrial and financial center stemmed from the banana trade in the first half of the twentieth century.

In 2017, after six decades of operating as a correctional facility, the Presidio was razed. Simultaneously, the city started to plan an urban redevelopment project known as the District of Technology, Culture, and Opportunities (DTCO). The DTCO will be developed in two phases:

- **Phase 1**: Develop 17 million square meters on the lot previously housing the Presidio; and
- **Phase 2**: Develop 15 million square meters on an adjacent lot currently home to the Instituto Tecnológico Sampedrano, a technology institute.

The location of the project and the surrounding neighborhoods is described in Figure 20.

Figure 20: Location of the DTCO in San Pedro Sula



The municipality of San Pedro Sula has engaged in broad stakeholder consultation to develop the DTCO:

- A citizen survey in 2017 recorded 15,000 responses from community members, including inhabitants of the immediate neighborhoods, as well as schools and universities.
- Subsequently, a table for dialogue, with the participation of the Presidency of the Republic, the Municipality of San Pedro Sula, and business leaders, explored options for the DTCO.
- The dialogue continued in 2019 with the interest and participation of the Inter-American Development Bank.

Through this consultative process, the DTCO planning process focuses on three pillars:

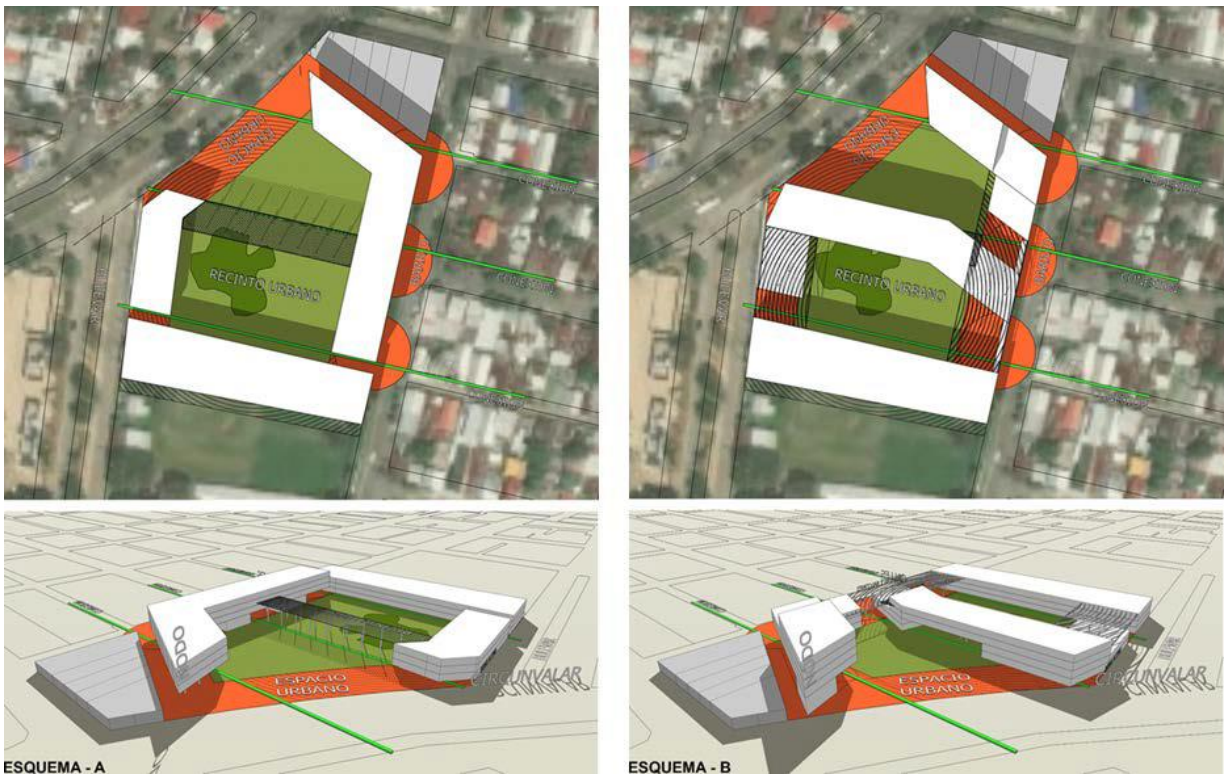
- Collaborative Promotion of the Digital Economy;
- Learning and Opportunity for Innovation; and
- Social Integration and Quality of Life.

Further DTCO planning will occur during the proposed project. At this time, the municipality expects the principal DTCO facilities to include:

- Spaces for education and technology learning programs;
- Incubators for training and support of small innovation companies;
- Open outdoor areas for free activities, exercise, sport, culture, and internet access;
- Spaces for career support and job search; and
- Shops, services, and other businesses to ensure financial sustainability, generate pedestrian traffic, and provide community coexistence.

An artist's rendering of DTCO Phase I alternatives is provided in Figure 21.

Figure 21: Artist's Rendering of DTCO Phase I Alternatives



Additional features of the DTCO include:

- Urban mobility (full streets) and underground parking lots;
- Energy efficiency and sustainable development;
- A multi-functional project with activities focused on employment, technology, and generous public spaces;
- Innovation; and
- Integration with the Bio-Healthy Boulevard "Chelato Ucles."

Critical technical characteristics of the DTCO will include:

- Fiber optic broadband connections;
- A highly reliable power supply;
- A data center (Phase II);
- A Smart City Control Center (C3i[38], Phase II); and
- A 5G pilot rollout (Phase II).

The project also includes a smart city pilot implementation. In addition to an initial version of the Smart City Control Center (C3i), the smart city pilot includes:

- Initial applications for urban services:
  - Urban mobility;
  - Citizen safety; and
  - Water and waste management.
- Initial phase e-Government solutions for citizen interactions with the municipal government.

PROJECT STATUS AND IMPLEMENTATION TIMELINE

Financing for the project was approved in December 2019. Project implementation commenced in 2020 but has experienced delays due to the COVID-19 global pandemic. The original project concept contemplated a five-year implementation period, as shown in Table 22:

Table 22: DTCO Implementation Plan

Activity / Milestone	Year 1	Year 2	Year 3	Year 4	Year 5
Digital Talent Promotion					
Building Information Capacity Development					
Digital District Master Plan					
Digital District Design					
Digital District Construction					
Smart City Initial Applications					
Smart City Operational Center					

PROJECT COST AND FINANCING

The budget for project implementation is $18.93 million, allocated as follows:

- $10.93 to be provided by the IADB through component 3.2 of loan HO-L1202; and
- $8.0 million local funding to be provided by the San Pedro Sula local government.

Most of this budget is assigned to the DTCO. The budget for the smart city pilot is $2.275 million.

[38] C3i – Centro de Control de Ciudad Inteligente

The IADB loan HO-L1202 totals $44.7 million and includes other components on a national scale:

- Component 1: $10.3 million for broadband coverage and use;
- Component 2: $17.6 million for the digital transformation of the government;
- Component 3.1: $2.1 million for the national scope portion of the digital economy; and
- Component 4: $3.8 million for administration, audit, and evaluation.

U.S. EXPORT OPPORTUNITIES

Export opportunities for U.S. companies for the DTCO and smart city pilot will include:

- Phase I ICT and power supply infrastructure:
  - Fiber optic network hardware and installation technology; and
  - Reliable power supply.
- Phase II infrastructure:
  - 5G network equipment and rollout;
  - A data center;
  - The Smart City Control Center;
  - Cybersecurity software, services, and training;
  - Data and control center design, planning, and engineering services;
  - Network operations services and training; and
  - Cloud services.
- Smart city equipment and solutions:
  - Sensors including geospatial, traffic/transportation/parking, security, and weather;
  - Cameras and video content analytics;
  - Traffic and signal systems and software; and
  - Supporting IT equipment and software, including geospatial, emergency, health crisis, and disaster management applications.

CONTACTS

Project Sponsor	U.S. Trade and Development Agency	U.S. Commercial Service
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10 Jamaica

10.1 ICT Demographics

Jamaica is the third-largest Caribbean island nation, sitting south of Cuba. The terrain is mountainous with narrow, discontinuous coastal plains. Jamaica's landmass is 10,831 square kilometers, slightly smaller than the U.S. state of Connecticut. Forty-one percent of the country's land is agricultural, and another 31 percent forest. Natural hazards include hurricanes.

Tourism and alumina are the two largest exports. As a result, the Jamaican economy has suffered heavily during the COVID-19 global pandemic.

Jamaica is home to approximately 2.8 million people. Population density is high across the island, with Kingston, Montego Bay, and Esquivel the largest population centers.

10.2 ICT Sector Development

As measured by telephone, internet, and fixed broadband access, Jamaica's existing ICT sector is below world averages. The country ranks 99th and 137th globally in terms of total fixed broadband and mobile cellular subscriptions, respectively, and 94th for fixed broadband and 117th for mobile cellular subscriptions globally, on a population-adjusted basis[39].

Jamaica ranks 109th globally in terms of the percentage of its population with access to the internet. In 2018, approximately 55 percent of the population had internet access[40].

Urban populations comprise about 57 percent of ICT infrastructure users in Jamaica.

Jamaica has subsea fiber optic cable access to the following:

- The 2,400 km Colombia-Florida Subsea Fiber (CFZ-1). The cable lands in Jamaica at Copa Club and Morant Point.
- The 1,860 km ALBA-1 cable connecting Cuba and Venezuela. The Jamaican landing point is Ocho Rios.
- The 1,750 km East-West cable connecting the Dominican Republic, Jamaica, and the Virgin Islands (U.K.), with a Jamaican landing point at Harbour View.
- The 1,000 km Fibralink cable connecting the Dominican Republic, Haiti, and Jamaica. This cable lands at Bull Bay, Montego Bay, and Ocho Rios.
- The 870 km Cayman Jamaica Fiber System (CJFS), connecting four points in Jamaica with two in the Caymans. Jamaican landing points for the cable are Bull Bay, Montego Bay, Ocho Rios, and Port Antonio. This cable has onward service to the MAYA-1line connecting to Mexico and the United States.

[39] International Telecommunications Union
[40] World Bank

The country does not own any satellites.

10.3 Regulatory Landscape

The Office of Utilities Regulation (OUR) regulates the telecommunications sector in Jamaica under the Telecommunications Act. The Office regulates specified services and facilities, receives and processes applications for licenses, and promotes consumers' interests. The Office also oversees electricity, water, and sewage.

The Jamaica Public Service Company is an integrated electric utility and the only distributor of power in Jamaica. The company also hosts nationwide fiber optic communication cables.

Broadcast media in Jamaica is in the private sector. Approximately 30 radio and three free-to-air television stations service the island. Cable and satellite television services are available also.

10.4 ICT Sector Profiled

This Resource Guide reviews two ICT sectors:

- *Smart Cities and e-Government:* The USTDA has provided a grant to the Jamaica Public Service Company to undertake a smart cities project, including smart metering and e-mobility efforts in the New Kingston area. This project is profiled following. The island nation undertook a $68 million e-Government project in 2017 funded primarily by the Inter-American Development Bank (IDB) to develop a National Identification System (NIS). The project was modeled on an Estonian effort that succeeded in digitizing approximately 90 percent of government functions for online access.

- *Internet of Things (IoT) and Artificial Intelligence (AI):* Jamaica is early in developing IoT and AI technology uses. The GraceKennedy Group, one of Jamaica's largest private-sector companies and of the largest conglomerates in the Caribbean, is undertaking a project to digitize its operations, including several IoT and AI applications. Focal areas for the GraceKennedy project profiled following are improved customer experience and enhanced operational efficiency. The project includes the implementation of digital payment systems.

10.5 Projects Profiled

Two ICT projects in Jamaica are profiled, as described in Table 23:

Table 23: ICT Development Project -- Jamaica

Project	Sponsor
Jamaica Public Service Smart City	Jamaica Public Service Company
GraceKennedy Digital Transformation	GraceKennedy Group

Jamaica Public Service Smart City Pilot	
SUBSECTOR	**Smart Cities and e-Government**
LOCATION	**Jamaica**
PROJECT VALUE	**$78 million for Kingston Pilot**

PROJECT SUMMARY

- Jamaica Public Service Company (JPS) is engaged in the generation, transmission, and distribution of electricity and purchases power from several independent power producers. JPS has established a smart city development program and is currently making significant investments in several smart grid initiatives, including:
  - A nationwide smart LED street light deployment;
  - Expanding smart meter technology; and
  - Investment in an RF telecommunication infrastructure providing real-time information for both systems.
- STDA is providing a grant to JPS to support the preparation of a Smart City Roadmap, initially as a demonstration effort in the New Kingston area of Kingston, Jamaica.
- The technical assistance objective is to determine the technical, financial, and economic viability of a proposed smart city project for Jamaica leveraging the smart lighting infrastructure and control systems already implemented in New Kingston.
- The Smart City Roadmap includes developing a Smart City Vision and Stakeholder Engagement Strategy and Conceptual Urban Planning and Design for the area.

PROJECT BACKGROUND AND DESCRIPTION

JPS is engaged in the generation, transmission, and distribution of electricity and purchases power from several independent power producers (IPPs). Marubeni Corporation of Japan and East-West Power Company (EWP) of Korea are majority shareholders (40% each) of the shares in JPS. The Government of Jamaica and a small group of minority shareholders own the remainder.

JPS has been implementing smart grid technology, including undertaking an advanced metering infrastructure (AMI) program, to improve operating efficiencies within the utility. The smart grid initiatives had a total budget of $120 million through 2020, with most of the funds deployed to implement smart meters and smart street lighting. This smart city initiative will leverage the ICT investment already made by JPS to deploy smart grids and smart street lighting.

To initiate the effort, JPS has decided to develop a Smart City Infrastructure Roadmap. Tuatara Group will execute the Smart City Infrastructure Plan under the USTDA grant. The effort will focus on transitioning Kingston into a Smart City by establishing a public-private partnership

(PPP). The PPP will prepare an ICT infrastructure transformation plan and a business case and assist JPS in deploying critical technologies required to achieve Smart City ICT infrastructure transformation. To support its Smart Grid effort, JPS leverages an extensive communications network consisting of an outer fiber ring that connects to most of its 55 substations. There is also an inner ring connecting to the corporate network and a microwave ring. JPS is also planning a new RF Mesh communication network as part of its Smart Grid and Smart Street lighting efforts.

JPS is a vertically integrated electric utility company and the only distributor of electricity for Jamaica. JPS is addressing urban challenges in partnership with the public and private sectors by putting in place the governance, infrastructure, and enabling activities to establish Kingston as a leading smart city. The Company is a leader in the energy sector and has been working with several stakeholders to shape national policy and create smart city implementation frameworks. JPS has invested in smart grid and smart street lighting efforts and is now focusing on other smart technologies for Kingston. These include:

- Electric power smart grid,
- Electric vehicle charging stations,
- Communication and digital signage,
- Security and emergency response systems,
- Public Wi-Fi,
- Traffic control systems,
- Solid waste management logistics management systems,
- Water supply and wastewater treatment system automation, and
- GIS mapping.

The USTDA supported technical assistance to develop a Smart City Roadmap initially as a demonstration effort in the New Kingston area of Kingston. The technical assistance objective is to determine the technical, financial, and economic viability of a proposed smart city project for Jamaica leveraging the smart lighting infrastructure and control systems already implemented in New Kingston. The Smart City Roadmap includes developing the Smart City Vision and Stakeholder Engagement Strategy and Conceptual Urban Planning and Design for the area. New Kingston is one of two central downtown districts of Kingston. New Kingston's area is approximately 6 km^2 and is depicted in Figure 22.

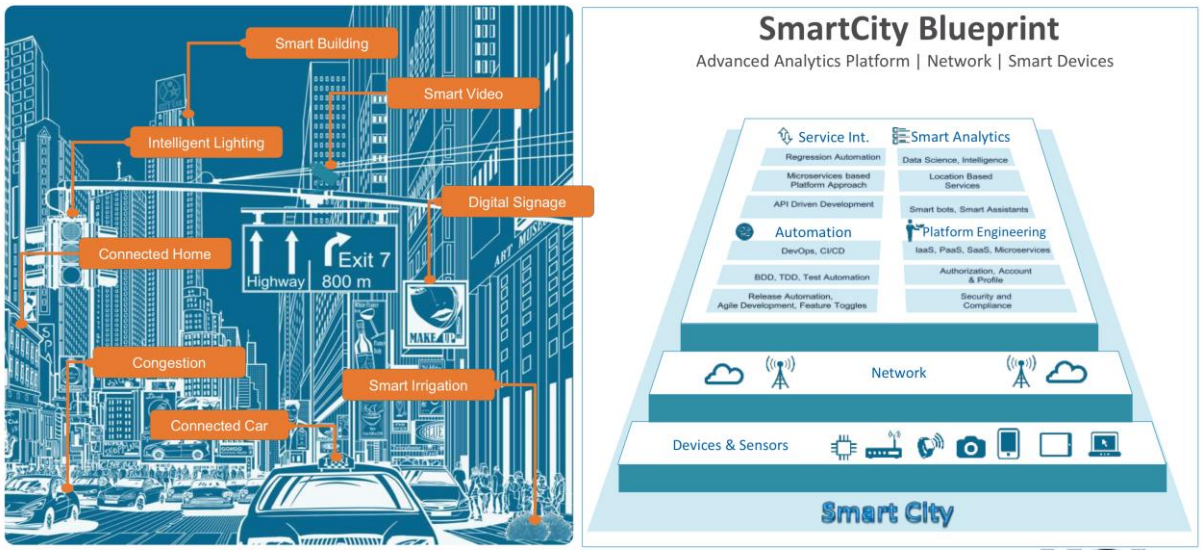
The principal efforts of the Project are:

- Stakeholder outreach;
- Sector assessments and market research;
- Conceptual urban planning and design;
- Technology recommendations;
- ICT solution selection for management and control; and
- Developing a Smart City Roadmap.

Figure 22: New Kingston Area

The specific smart city initiatives to be deployed will be defined during the planning effort. Some of the most likely technologies are shown in Figure 23 and relate to traffic management, communications, safety, smart utilities, and electric vehicle charging systems.

Figure 23: Typical Smart City Blueprint



PROJECT STATUS AND IMPLEMENTATION TIMELINE

The USTDA-funded technical assistance project to develop the Smart Cities Roadmap is scheduled to be completed in 2021. Implementation of the demonstration projects in the New Kingston Area is likely to require about two years. Measurements of success will take another year. Depending upon the solutions selected, the implementation across Kingston could take an additional two-to-four years. Thus, full implementation across the whole municipal area will occur in the 2026 to 2029 timeframe.

U.S. EXPORT OPPORTUNITIES

Export opportunities exist for U.S. firms offering smart city solutions. The Project requires a wide range of ICT systems, software, and services to support the Smart Cities Infrastructure implementation. These include:

- Smart city pilot infrastructure:
  - Wireless communications infrastructure;
  - Metro network infrastructure;
  - A data center;
  - A city service operation center; and
  - Smart city ICT infrastructure planning and execution.

- Smart city applications;
  - Smart parking;
  - Electric vehicle charging;
  - Transit;
  - Video surveillance;
  - Water and waste management;
  - Lighting;
  - Energy;
  - Resident security & safety; and
  - Personal healthcare.

- Additional smart city solutions:
  - A municipal data platform;
  - Business services data platforms;
  - Network security;
  - Smart home & applications; and
  - An advanced traffic management system (ATMS).

CONTACTS

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GraceKennedy Digital Transformation	
SUBSECTOR	**Internet of Thing (IoT) and Artificial Intelligence (AI)**
LOCATION	**Jamaica and International Locations**
PROJECT VALUE	**$20 million (estimated, undisclosed)**

PROJECT SUMMARY

- The GraceKennedy Group is one of the Caribbean's largest conglomerates, operating in the financing and food sectors.
- In 2020, the Group announced the commencement of its digital transformation, focusing on three pillars:
  - Improved customer experiences;
  - Digitizing for operational efficiency; and
  - A digital-first culture.
- The first phase of implementation will focus on the Group's financial service businesses.
- A second phase will cover domestic and international food businesses.

PROJECT BACKGROUND AND DESCRIPTION

The GraceKennedy Group (GK) is a conglomerate comprising over 60 operating companies in the financial and food sectors:

1. *Financial Services*: First Global Bank, SigniaGlobe Financial Group, GK Investments, and GK Capital Management;
2. *GraceKennedy Money Services (GKMS)*: an umbrella brand for services offered by Western Union, FX Trader, and Bill Express in a network of over 300 location across Jamaica;
3. *Insurance*: life and general insurance in Jamaica and the Eastern Caribbean;
4. *GraceKennedy Foods*: the Caribbean's leading distributor of food and non-food consumer products;
5. *Food Manufacturing*: in six factories across Jamaica; and
6. *Retail*: Hi-Lo Food Stores, the second-largest supermarket chain in Jamaica.

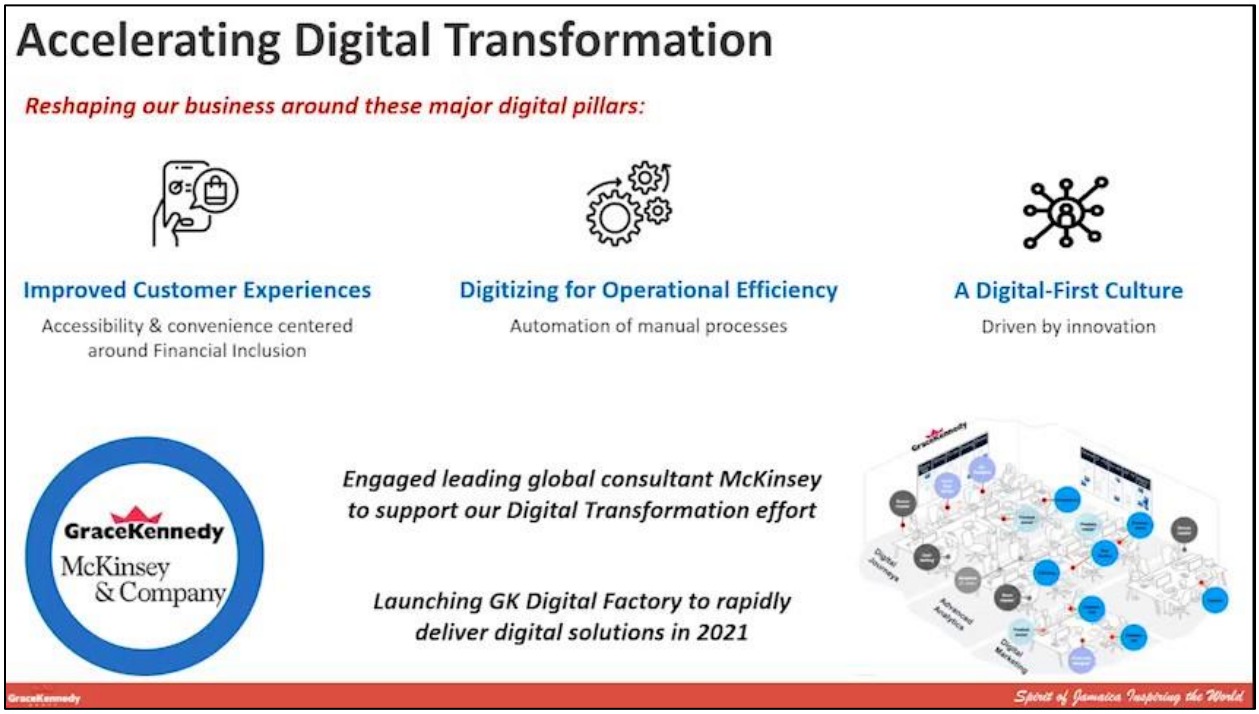
GK operates in the Caribbean region, Central America, North America (U.S. and Canada), and the United Kingdom.

GK's digital transformation focuses on three pillars, as shown in Figure 24:

- Improved customer experiences;

- Digitizing for operational efficiency; and
- A digital-first culture.

Figure 24: Pillars of GraceKennedy's Digital Transformation



GK has engaged McKinsey to support the digital transformation effort and the rollout of the initial solutions.

GK's digital transformation takes advantage of lessons learned from GK Mpay, an electronic payment system launched in February 2017, and additional digital transformation learnings. GK MPay was a mobile money service allowing users to conduct monetary transactions from a virtual account fully backed by funds in a regulated virtual account.

Through GK MPay, the company sought to get Jamaicans, especially those who are not holders of bank accounts, into the formal system through the execution of a range of transactions from a mobile device. Transactions handled by GK MPay included:

- Bill payment;
- Top-up of phone credit;
- Peer-to-peer transfers; and
- Purchases from established merchants or sidewalk vendors.

GK also sought to win over Jamaicans receiving remittances. The Bank of Jamaica approved users of GK MPay to collect remittances via the platform in Western Union outlets across the island.

GK suspended MPay in February 2019, pending the launch of a new version. In December 2019, the company announced the withdrawal of GK MPay. GK indicated the mobile money product did not meet its expectations. Feedback from GK MPay customers and stakeholders has since supported the design of the company's new digital transformation initiative.

One of GK's digital transformation initiatives has been adapted to the fintech regulatory Sandbox guidelines published by the Bank of Jamaica.[41] The Sandbox aims to provide a platform to test innovative financial products, services, and businesses in a live market environment. Specific objectives of the Sandbox include:

- Encouraging innovation in financial products and services;
- Incentivizing the digitization of financial services by encouraging innovative solutions;
- Promoting competition in price and product offerings for financial service consumers; and
- Enhancing access to digital financial services to achieve sustainable financial inclusion.

The Sandbox will provide a controlled environment for deploying financial technology while ensuring appropriate safeguards to manage risks, including the risks of product failure and jeopardizing the financial system's integrity and stability. GK and McKinsey expect the Regulatory Sandbox will reduce the time and potentially the costs incurred in getting innovative products to market.

PROJECT STATUS AND IMPLEMENTATION TIMELINE

GK appointed a Head of Digital Transformation on August 1, 2020. The company also named a Digital Transformation Steering Committee, chaired by the Group CEO. The Steering Committee is charged with overseeing the advancement of the digital agenda across the GK domestically and internationally.

The first phase of implementation will focus on the Group's financial service businesses. Future phases will cover the needs of the domestic and international food businesses.

PROJECT COST AND FINANCING

GK has not disclosed a budget for the Group's digital transformation. However, the company does expect the project to provide significant opportunities for cost reduction.

GK's annual reports indicate investment in software of approximately $2 million in both 2018 and 2019. Therefore, we estimate the budget for the digital transformation to be at least $20 million.

U.S. EXPORT OPPORTUNITIES

Opportunities for U.S. companies for GK's digital transformation include:

[41] Bank of Jamaica. Fintech Regulatory Sandbox Guidelines. March 2, 2020.

- Chatbot and virtual assistant applications and support;
- Robo-advisor applications and support;
- Credit assessment applications and support;
- Legal and compliance applications and support;
- Blockchain technology;
- AI and robotic process automation;
- SAAS and cloud-based solutions for InsurTech, RegTech, HealthTech, and FinTech;
- Advisory services; and
- Project commercialization and technology transfer support.

CONTACTS

Project Sponsor	U.S. Trade and Development Agency	U.S. Commercial Service
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11 OECS Regional Project

11.1 ICT Demographics

One project reviewed in this resource guide covers four of the Organization of Eastern Caribbean States (OECS) members (Dominica, St. Lucia, St. Vincent and the Grenadines, and Grenada). ICT demographics of countries involved in these projects and not covered previously are provided in Table 24.

Table 24: Regional ICT Demographics – Countries Not Previously Covered[42],[43]

Country	Landmass (sq km)	Infrastructure Hazards	Population (000)	Population Centers
Dominica	751	Hurricanes, flash floods	75	Mostly along the coast. St. George and Roseau (capital) are large centers. The volcanic interior is sparse.
St. Lucia	606	Hurricanes	167	Periphery, with largest in the north near the capital city, Castries.
St. Vincent and the Grenadines	389	Hurricanes, volcano	101	Kingston metropolitan area

11.2 ICT Sector Development

Levels of ICT sector development for countries involved in the OECS project (and not elsewhere covered) are provided in Table 25. The level and complexity of ICT infrastructure development and consumer access vary across the OECS.

[42] World Bank https://data.worldbank.org/indicator/SP.POP.TOTL
[43] CIA World Factbook https://www.cia.gov/the-world-factbook/

Table 25: ICT Sector Development – Countries Not Previously Covered[44]

	World Rank				
Country	Broadband Total Subscriptions	Mobile Phone Total Subscriptions	Broadband/100 People	Mobile Phones/100 People	Percent Population Using the Internet
Dominica	160	187	75	105	79
St. Lucia	135	176	69	116	114
St. Vincent and the Grenadines	140	183	51	130	158

11.3 Regulatory Landscape

Regulators of the additional OECS countries profiled in this section are described in Table 26:

Table 26: Regional Regulators – Countries Not Previously Covered

Country	Regulator	Oversight
Dominica	National Telecommunications Regulatory Commission (NTRC)	Coordinates telecommunications regulatory regime. Promotes open competition in telecommunications, harmonizes policies on a regional level for telecommunications, provides for universal service, fair pricing, and uses cost-based pricing methods by telecommunications providers.
St. Lucia	National Telecommunications Regulatory Commission (NTRC)	Established to uphold the Telecommunications Act of 2000, including General Regulatory, Frameworks and Technical Standards, Tariffs and Pricing, Numbering, Spectrum Monitoring and Management, Amateur Radio, and Dispute Resolution
St. Vincent and the Grenadines	National Telecommunications Regulatory Commission (NTRC)	Promotes open competition in telecommunications, harmonizes policies on a regional level for telecommunications, provides for universal service, fair pricing, and uses cost-based pricing methods by telecommunications providers.

The countries above have a mix of public and private broadcast media, as shown in Table 27.

[44] Index Mundi https://www.indexmundi.com/facts/indicators/IT.NET.BBND.P2/rankings

Table 27: Broadcast Media Control – Countries Not Previously Covered

Country	Broadcast Media
Dominica	No terrestrial television. Cable by subscription with some content locally produced. Six state-owned radio stations with approximately another 15 privately-owned.
St. Lucia	One public television station operating on cable plus three privately-owned stations. Multichannel cable television is available. The approximately 25 radio stations are a mix of state-owned and private. Cable television also available. One partially government-funded radio station with about 12 private stations.
St. Vincent and the Grenadines	The state-owned network operates one television and five repeater networks covering the country.

11.4 ICT Sector Profiled

The OECS project reviewed in this Resource Guide addresses:

- *Smart Cities and e-Government and Cybersecurity*: The Organization of Eastern Caribbean States is undertaking the Caribbean Digital Transformation Project. The OECS intends to spur economic growth and development by creating a digital enabling environment and digital infrastructure and services and supporting broader technical skills and technology adoption across Dominica, Grenada, St. Lucia, and St Vincent and the Grenadines. These relatively small economies will benefit from the scale and scope economies created during the effort. Today, the included countries are generally below world averages in ICT development.

11.5 Projects Profiled

The OECS project profiled, as described in Table 28:

Table 28: ICT Development Projects – Eastern Caribbean Region

Project	Sponsor
Caribbean Digital Transformation Project	Organization of Eastern Caribbean States

Caribbean Digital Transformation Project	
SUBSECTOR	**Smart Cities and e-Government Cybersecurity**
LOCATION	**Eastern Caribbean: Dominica, Grenada, St. Lucia, and St. Vincent and the Grenadines**
PROJECT VALUE	**$94 million**

PROJECT SUMMARY

- The Eastern Caribbean countries face a unique set of challenges:
  - Small economies and populations;
  - Significant hurricane risk;
  - Limited growth in tourism even before the COVID-19 global pandemic compared to other Caribbean locations; and
  - High unemployment with substantial losses of skilled talent to other geographies.
- Digital transformation offers an exceptional opportunity to spur growth and development.
- This project aims to increase access to digital services, technologies, and skills by governments, businesses, and individuals in the four participating countries.
- The project consists of four components:
  - A digital enabling environment;
  - Digital government infrastructure, platforms, and services;
  - Digital skills and technology adoption; and
  - Project implementation support.
- The World Bank approved the project in June 2020.

PROJECT BACKGROUND AND DESCRIPTION

The Eastern Caribbean region is characterized by small economies and populations, as well as unique geographic conditions. The total population of the seven Organization of Eastern Caribbean States (OECS) member countries is approximately 625,000, with a cumulative GDP of under US$9 billion. As islands, the OECS member states lack direct physical connections to large markets. All fall within the Atlantic Hurricane belt.

The OECS countries struggle to build on their physical and human capital endowments to generate adequate economic opportunities. GDP growth averaged just 1.3 percent for Caribbean small island states in 2018 and is expected to fall precipitously in the wake of the COVID-19 global pandemic. Further, these countries face a substantial skills-job mismatch among graduates of the formal education system. The region suffers from top talent leaving to seek opportunities in global markets. Before the COVID-19 global pandemic, unemployment was already high, with youth unemployment reaching as high as 40 percent in some jurisdictions.

Smaller and less diversified economies in the Caribbean will be most affected by the demand (reduced consumer spending) and supply (cancellation of flights and cruises) shocks to tourism due to COVID-19. Before the pandemic, tourism had already been losing share, with arrivals rising only 0.6 percent annually from 2005-2017, compared with 4.2 percent globally.

While the competitiveness of the services sector increasingly relies on technology and digital platforms to serve the modern consumer demands, few OECS businesses are rising to this challenge. Further, few local workers are equipped with the technology and soft skills needed to drive a digital transformation. This project's objective is to increase access to digital services, technologies, and skills by governments, businesses, and individuals in the participating Eastern Caribbean countries.

The project will ensure monitoring of key performance indicators, including:

- Internet penetration (%);
- Adults with access to an e-money account;
- Users of digital public services reporting satisfaction with the efficiency of transactions;
- Number of individuals utilizing digital skills to improve workplace productivity or secure new employment opportunities; and
- Number of firms adopting digital technologies and platforms for business purposes.

The project comprises four components:

Component 1: Digital Enabling Environment
Objective: To support the development of a positive enabling environment for the region's digital economy to drive investment and innovation while promoting trust in and security of online transactions.

Component 1 comprises three subcomponents in telecommunications, financial services, and cyber security:

Subcomponent 1.1: Telecommunications: Legal and Regulatory Environment, Institutions, and Capacity

- Conduct a legal and regulatory framework review;
- Develop quality of service monitoring and enforcement methodology; and
- Ensure network resilience and post-disaster recovery action plans.

Subcomponent 1.2: Digital Financial Services: Legal and Regulatory Environment, Institutions, and Capacity

- Propose updates to the Eastern Caribbean Currency Union Payment Systems and Money Services Business Acts;
- Develop demand-side surveys on financial access and usage;
- Create an overarching payment systems strategy for the region; and

- Design a regional instant payment system.

Subcomponent 1.3: Cybersecurity, data protection, and privacy: Legal and regulatory environment, institutions, and capacity

- Conduct a cybersecurity policy, regulatory, and institutional review;
- Create national-level cybersecurity agencies and emergency response teams;
- Coordinate regional capacity building; and
- Update regional and national data protection and privacy laws.

Component 2: Digital Government Infrastructure, Platforms, and Services
Objective: To support public sector modernization, resilience, and delivery of digital public services to individuals and businesses.

Component 2 comprises two digital government-focused subcomponents:

Subcomponent 2.1: Cross-cutting Enablers of Digital Government Operations and Services

- Develop national digital transformation strategies;
- Update regulations for e-transactions, digital signatures, and identification;
- Develop data centers and infrastructure to support e-Government;
- Create a digital identification system or user authentication platforms;
- Install electronic document management with digital signature capabilities;
- Provide a digital payment platform to support all e-Government functions; and
- Build capacity for change management across the public service.

Subcomponent 2.2: Government Productivity Platforms and Citizen-Centric Digital Services

- Digitize and integrate registries and information systems;
- Reengineer business processes with end-to-end digitization;
- Create online web and mobile applications to access public services;
- Develop geographic information systems for property information and transactions;
- Create an electronic single window for customs clearance and administration;
- Develop an electronic tax administration system;
- Digitize and automate tourism and immigration;
- Digitize health information and administration; and
- Digitize social cash transfers.

Component 3: Digital Skills and Technology Adoption

Objective: To better equip individuals and businesses across the region for the future jobs and economy and spur innovations and productivity growth.

Component 3 comprises two subcomponents focused on developing workforce and public skills and acceptance of digital methods:

Subcomponent 3.1: Workforce-Ready Digital Skills

- Conduct a survey to identify the greatest demands for technical and soft skills;
- Develop a regional-level, advanced digital skills development and coaching program; and
- Conduct the regional-level digital skills development and coaching program.

Subcomponent 3.2: Technology Adoption

- Accelerate the adoption of digital technologies in priority sectors;
- Promote the use of electronic payment methods;
- Provide internships to facilitate the placement of individuals with newly-acquired digital skills;
- Provide support for innovation programs and co-working spaces; and
- Support purchases of digital devices and content by vulnerable groups and for remote learning.

Component 4: Project Implementation Support

The project's cost-benefit analysis, Component 4, will quantify the numerous benefits arising from project implementation, including:

- GDP increases from improved penetration of both fixed and mobile broadband;
- Opportunity cost savings from improved resilience of digital infrastructure;
- Cost savings for the public and private sector from electronic payment platforms;
- Efficiency gains in tax collection;
- Improved quality of life and citizen satisfaction from digital public service delivery;
- Reduced greenhouse gas emission resulting from reducing the trips required for transactions; and
- Increased job creation and tax collection from new digital employment.

Five agencies will implement the project:

- The Ministry of Public Works and Digital Economy of Commonwealth of Dominica;
- The Ministry of National Security, Public Administration, Home Affairs and ICT of Grenada;
- The Department of Public Service, Ministry of Finance of Saint Lucia;
- The Ministry of Finance, Economic Planning, Sustainable Development and Information Technology of Saint Vincent and the Grenadines; and
- The OECS Commission.

PROJECT STATUS AND IMPLEMENTATION TIMELINE

The project was approved on June 20, 2020. Implementation will occur from 2021 to 2026. The OECS expects annual disbursements as shown in Table 29:

Table 29: Eastern Caribbean Digital Transformation Project Annual Disbursements, 2021-2026 ($ Million)

Fiscal Year Ending June 30	Annual, $million	Cumulative, $million
2021	4.0	4.0
2022	10.0	14.0
2023	16.0	30.0
2024	22.0	52.0
2025	23.0	75.0
2026	19.0	94.0

The five implementing agencies plan to announce consultancy assignments for project implementation during 2021. Dominica and Saint Vincent and the Grenadines plan to release RFPs for goods and works during the period 2021 to 2024.

PROJECT COST AND FINANCING

Project financing consists of an $8 million International Development Association (IDA) grant to the OECS plus a total of $86 million in IDA credits to the four Caribbean countries for a total project cost of $94 million. Estimated project costs by participant and component are provided in Table 30:

Table 30: Financing Structure for Eastern Caribbean Digital Transformation by Country ($ Million)

Project Component	*DOM*	*GRE*	*SLU*	*SVG*	*OECS*	*Total*
1. Digital Enabling Environment	**2.0**	**2.5**	**3.5**	**2.0**	**5.0**	**15.0**
1.1 Telecommunications	*0.0*	*0.0*	*0.0*	*0.0*	*1.5*	*1.5*
1.2 Digital financial services	*0.0*	*0.0*	*0.0*	*0.0*	*1.5*	*1.5*
1.3 Cybersecurity and privacy	*2.0*	*2.5*	*3.5*	*2.0*	*2.0*	*12.0*
2. Digital Government	**16.3**	**0.0**	**7.8**	**22.7**	**0.0**	**46.8**
2.1 Cross-cutting enablers	*3.8*	*0.0*	*6.8*	*5.7*	*0.0*	*16.3*
2.2 Platforms and digital services	*12.5*	*0.0*	*1.0*	*17.0*	*0.0*	*30.5*
3. Digital Skills and Technology	**6.5**	**4.5**	**6.7**	**2.8**	**1.7**	**22.2**
3.1 Workforce-ready skills	*2.0*	*1.0*	*1.7*	*1.0*	*1.7*	*7.4*
3.2 Technology adoption	*4.5*	*3.5*	*5.0*	*1.8*	*0.0*	*14.8*
4. Project Implementation Support	**3.2**	**1.0**	**2.0**	**2.5**	**1.3**	**10.0**
Total	**28.0**	**8.0**	**20.0**	**30.0**	**8.0**	**94.0**

U.S. EXPORT OPPORTUNITIES

Opportunities for exporting U.S. goods and services include the following:

- Supply and installation of the cybersecurity system;
- Procurement of hardware and software platforms for systems integration and implementation of unique digital identifiers, citizen authentication, and digital signatures;
- Systems integration and support for the introduction of unique digital identifiers, and development and implementation of the citizen authentication and digital signature solutions;
- Roll-out of national ID cards;
- Supply and installation of immigration kiosks at ports and airports;
- Supply and installation of the health management information system;
- Procurement of tablets;
- Expansion of smart stream functionality;
- Support for development of the national cybersecurity capability;
- Technical assistance (TA) for digital strategy, standards, business continuity, and protocols;
- TA for review of policies, legislation, and regulations and development of recommendations on necessary reforms to implement integrated ID system, authentication platform, digital signature, and electronic entry permit mechanisms;
- Development of technical requirements for ID system implementation and business process reengineering and end-to-end digitization of citizen-facing services;
- TA for development of an electronic entry permit mechanism;
- Feasibility for implementation of the health management information system;
- Digital content for distance learning; and
- Project implementation support.

CONTACTS

Project Sponsor	U.S. Trade and Development Agency	U.S. Commercial Service
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12 Regional Projects

One pan-regional project relates to Subsea Communications Infrastructure. Subsea fiber optic cables provide large amounts of regional, country, and global communication capacity with relatively short installation periods. While numerous cables exist in the Central America and Caribbean region, broadband costs remain high, and user access is limited in several countries. The Seaborn Caribbean System (CARICOM and Central America) – is a development-stage project for a new, Caribbean-region-wide network intended to replace limited bandwidth, 20-year-old ICT infrastructure.

Seaborn CARICOM Cable	
SUBSECTOR	**Subsea Communications Infrastructure**
LOCATION	**CARICOM**
PROJECT VALUE	**$800 Million**

PROJECT SUMMARY

Seaborn is an independent ICT infrastructure developer. The company is focused on developing and expanding its presence in the Caribbean and Central and South America. Current activities under Seaborn's Southern Hemisphere subsea cable network strategy include:

- Development of a new Caribbean subsea fiber-optic cable system linking to the Seabras-1 and MexUS cables.
- Extension of the company's Seabras-1 cable, connecting Brazil and the United States, to Recife, Pernambuco.
- Development of a subsea fiber-optic cable system between Mexico and the United States (MexUS).

Seaborn is currently assessing a next-generation submarine cable network's development and operation to serve 25 Caribbean and Central American countries. Integrated into Seaborn's existing Seabras-1 subsea cable and the planned MexUS cable system, the proposed network will provide high-capacity ICT infrastructure throughout the CARICOM region with a network design inherently delivering high availability.

PROJECT BACKGROUND AND DESCRIPTION

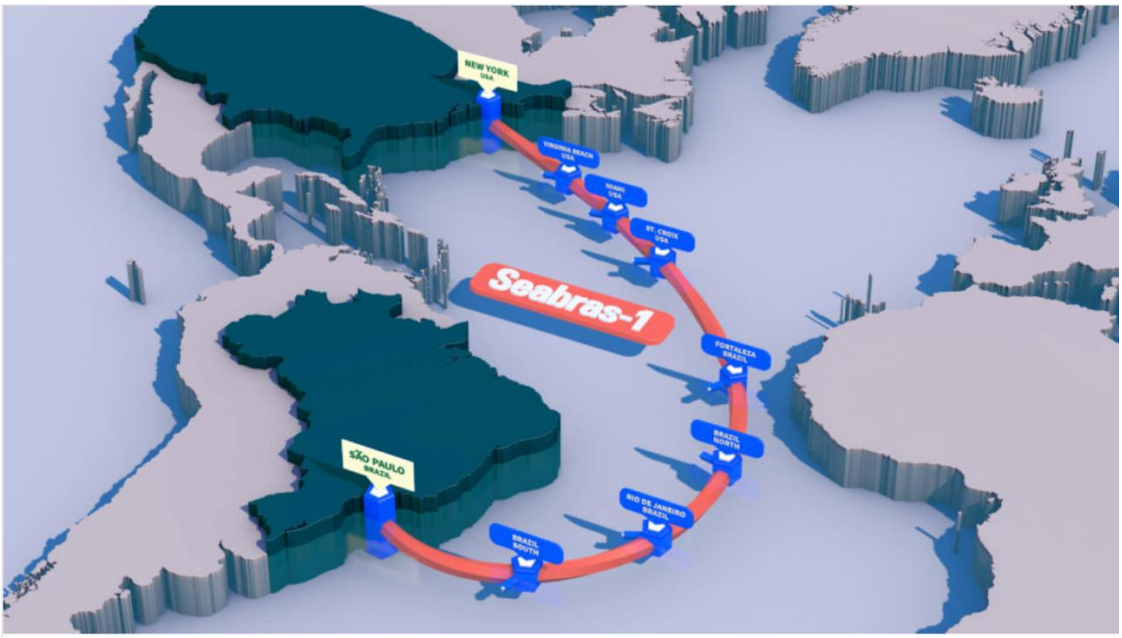
Seaborn, headquartered in Beverly, Massachusetts, U.S.A., is an independent infrastructure developer of subsea fiber optic cable systems and related ICT assets. The company fully operates and maintains its submarine cable system, landing stations, terrestrial backhaul, points of presence (PoPs), and metro connectivity. Seaborn also owns and operates primary and disaster-recovery network operations centers (NOCs). Its mission is to address global communications needs between South and North America for carriers, OTTs (over-the-top telecommunications providers), ISPs (internet service providers), HFTs (high-frequency trading financial services), enterprises, and governments.

The company completed its Seabras-1 cable in 2017. It provides direct PoP to PoP (Point of Presence) service from New York to São Paulo, landing in Brazil at Seaborn's Praia Grande landing station. Seabras-1 features six fiber pairs operating at 72 terabytes per second (Tbps).

Associated terrestrial routes in Brazil were all buried to enhance security. The cable includes 161 repeaters and multiple branching units, including (Figure 27).

The company also owns fiber infrastructure on AMX-1, a cable system connecting Rio de Janeiro and Jacksonville, Florida, U.S.A.

Figure 25: Seabras-1 Subsea Fiber Optic Cable Map



Seaborn has recently commenced three major infrastructure projects aimed at extending ICT capabilities across the Americas:

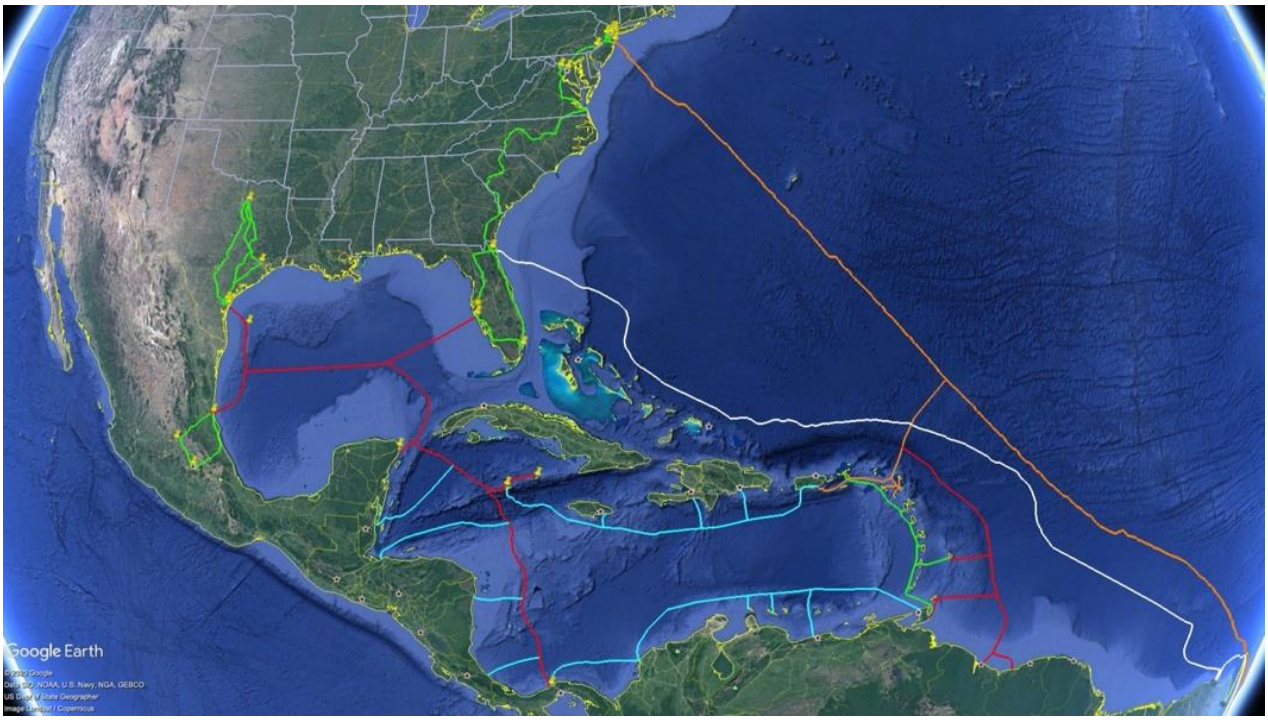
1. **Extension of the company's Seabras-1 cable, connecting Brazil and the United States, to Recife, Pernambuco** – the project will provide more efficient and cost-effective connectivity for northeastern Brazil.

2. **MexUs Cable** - this project will provide core connectivity among the United States, Mexico, Grand Cayman, and Panama, enabling onward connectivity to existing subsea and terrestrial ICT networks.

3. **Caribbean System** (CARICOM and Central America) - this development-stage project is a new, Caribbean-region-wide network intended to replace limited bandwidth, 20-year-old ICT infrastructure.

The interconnection of the Seabras-1 cable with these new assets will provide a modern, high-capacity communications network offering substantial connectivity improvement and cost reduction across the Latin American/Caribbean region (Figure 26).

Figure 26: Project Map – The Combined Seaborn Americas Network



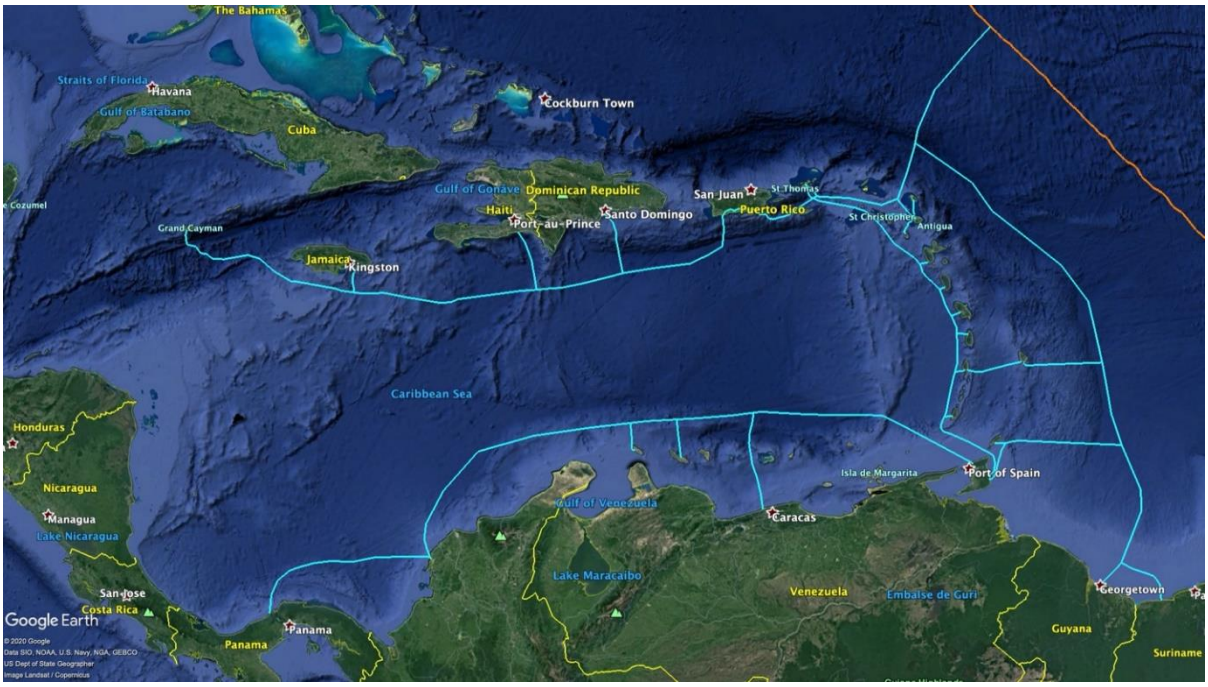
Seaborn is currently in the development stage for a new, region-wide cable network providing much-needed ICT subsea infrastructure throughout the CARICOM countries. The cable will extend 10,500 km in the region and feature six fiber pairs supporting a capacity of 72 terabytes per second (Tbps).

Existing subsea ICT infrastructure is over 20 years old and limited in bandwidth, capabilities, and remaining commercial life. Combined with a monopoly environment across the region that restricts the countries' abilities to develop local competition and sustainable regional ICT strategies, a new approach to regional connectivity is atop of the list of priorities for the region's legislative bodies.

The Seaborn CARICOM ICT network will provide (Figure 27):

- Reliable, high capacity bandwidth to the 25 countries identified
- A sustainable economic model with regional ownership of the network
- Sustainable bandwidth costs for international connections to the rest of the world
- Low-cost connectivity within the region.

Figure 27: Project Map – CARICOM Cable System



The network will enable region-wide health, education, and government collaboration and permit the first regional cloud strategy, directly benefiting the area's population. The Seaborn project provides a unique and viable economic model not previously available.

As a significantly underserved region over the past 20 years in terms of renewed ICT infrastructure, the replacement of aging infrastructure to enable sustainable ICT development throughout the area is a significant challenge to the governments involved. Seaborn intends the project to be built to benefit the countries involved with ownership and control of the network, a major factor in reducing ICT service costs throughout the region.

The combination of Seaborn's Caribbean and MexUS networks enables the development of four expansion branching units to Belize, Honduras, Nicaragua, and Costa Rica as part of a regional CARICOM initiative. The combined projects will deliver a Central American/Caribbean regional network supporting the ICT aspirations of the area for the next 25 to 30 years with a technologically advanced network (especially when compared to the aging systems currently serving the region) and an ownership structure for enabling regional and international ICT costs to be reduced significantly. Multiple points of entry into the region through existing ICT subsea infrastructure will provide resilience and service assurance.

PROJECT STATUS AND IMPLEMENTATION TIMELINE

Seaborn's CARICOM project is in the development stage, which the company expects to complete during the second quarter of 2021. Subject to financing, project implementation will commence in the third quarter of 2021.

PROJECT COST AND FINANCING

The Seaborn CARICOM system will require an investment of approximately $800 million to support the 10,500 km cable system. Seaborn expects regional and international development funding to represent the majority of financing, either on an individual country or a region-wide CARICOM basis.

U.S. EXPORT OPPORTUNITIES

Export opportunities for U.S. firms include:

- Fiber optic cabling hardware;
- Fiber optic network management hardware and software;
- Network modeling, design, and engineering services;
- Ship services/oversight;
- Installation/testing services/oversight; and
- Other technical and management advisory services.

CONTACTS

Project Sponsor	U.S. Trade and Development Agency	U.S. Commercial Service
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Annex A: ICT Sector Overviews

A1 Terrestrial Communications Network Infrastructure: Telephone, Internet, and Broadband

A1.1 Sector Overview

The vast majority of ICT network infrastructure resides on land. Nonetheless, key transmission infrastructure also exists in space (satellites) and on the ocean floor (see *Subsea Communications Infrastructure*).

Communications networks may be wired, wireless, or a combination of the two and may be as simple as the connection of devices within a home or as complex as serving millions of subscribers throughout a country or across the globe. Although modern technology has blurred the lines in terms of ICT networks and service crossovers, three key areas represent the majority of global communications:

- Telephony
- Broadband
- Internet

Terrestrial communications network infrastructure spans:

- Hardware and devices,
- Software and firmware,
- Network equipment,
- Supporting systems such as power, cooling, security, and dedicated facilities,
- Computing, application, and content platforms, and
- Related services, including telecommunications, broadband, and internet access, as well as service delivery.

A1.1.1 Telephony

For many decades, telephony was the principal mode of remote human communications. First introduced conceptually by Antonio Meucci, whose 1871, Alexander Graham Bell is more generally recognized as the inventor of the telephone. Telephony remained primarily analog/wired until the 1970s, when Martin Cooper, a Motorola engineer, developed the first-generation mobile telephone. In 1979, Nippon Telephone and Telegraph (NTT) deployed the first mobile network (using analog signals). In 1987, various European nations agreed to the use of GSM, or the second generation of mobile telephony -- digital, cellular, and with uniform standards. The adoption of mobile telephony was rapid thereafter, as shown in Table 31.

Table 31: Evolution of Mobile Telephony[45]

Generation	Speed	Technology	Key Features
1G (1970-1980s)	14.4 Kbps	AMPS, NMT, TACS	Voice only
2G (1990-2000)	9.6/14.4 Kbps	TDMA, CDMA	Voice and data
2.5-2.75G (2001-2004)	171.2 Kbps 20-40 Kbps	GPRS	Voice, data and web mobile internet, low-speed streaming services, and e-mail services
3G (2004-2005)	3.1Mbps 500-700 Kbps	CDMA2000 (1xRTT, EVDO) UMTS and EDGE	Voice, data, multimedia, support for smartphone applications, faster web browsing, video calling, and TV streaming
3.5G (2006-2010)	14.4 Mbps 1-3Mbps	HSPA	All 3G capabilities with enhanced speed and mobility
4G (2010-present)	100-300 Mbps 3-5 Mbps 100 Mbps WiFi	WiMAX LTE WiFi	High speed, high-quality voice over IP, HD multimedia streaming, 3D gaming, HD videoconferencing, and worldwide roaming
5G (2019 forward)	1-10 Gbps	LTE advanced schemes OMA and NOMA	Super-fast mobile internet, low latency network for mission-critical applications, Internet of Things, security and surveillance, HD multimedia streaming, autonomous driving, and smart healthcare applications

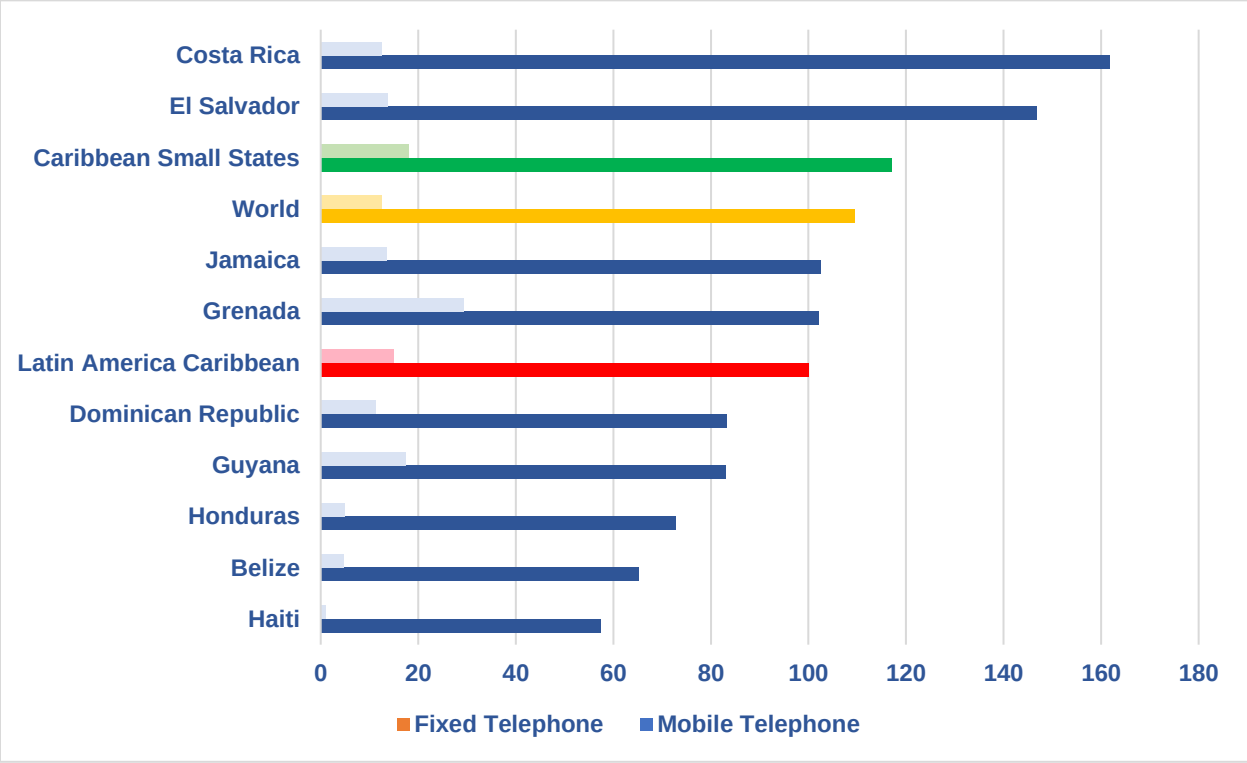
From 1987 to the present, the world has witnessed several new generations of mobile telephony. Each successive innovation provides faster speed, lower latency, and a wider range of capabilities in terms of content transmission capability. The current focus is on the successful implementation of 5G technology, which offers the ability to handle standard voice and data communications and the ability to power Internet of Things (IoT) devices, artificial intelligence (AI), and a wide array of other data-intensive applications.

[45] RFPage.com

While fixed telephony still exists worldwide, mobile telephony has been a boon to economically developing societies, giving more citizens telephone access more quickly due to less cumbersome infrastructure installation requirements. Typically, countries with earlier economic development trajectories have higher remaining use of fixed telephony, while those later-to-develop have higher levels of mobile to fixed telephone usage, as shown in Figure 28.

The Central American and Caribbean region is mostly at or above the world average in fixed telephony access but below the world average for mobile telephone penetration on a population-adjusted basis. However, Costa Rica and El Salvador substantially exceed both world and regional levels for mobile telephone subscriptions on a population-adjusted basis. The Caribbean nations, both because of their island geography and the importance of the tourist trade, generally have above-world cellular telephone usage per 100 people.

Figure 28: Fixed and Mobile Telephone Usage – Subscriptions per 100 People[46]



New technology developments include:

- Deployment of 5G (fifth generation) mobile telephony -- with faster speeds, lower latency, and ability to carry vast amounts of information, 5G will make demanding IoT and AI applications more feasible.

[46] World Bank https://data.worldbank.org/indicator/IT.CEL.SETS.P2

- Expanded use of SD-WAN (software-defined wide area network) -- this cloud-based architecture will continue the path of abstracting software from hardware to provide more elastic traffic management and WAN virtualization.

- Development of a sixth-generation (6G) approach to telecommunications -- using frequencies between 100 GHz and 1 THz. Still, in the early development stages, industry experts expect 6G may require a decade of development but could offer speeds up to one terabyte (TB) per second. That is the equivalent of 142 hours of movies delivered in one second.

A1.1.2 Internet

The internet is a global computer network consisting of interconnected networks using standardized communication protocols. It links smaller computer networks, including commercial, educational, governmental, and others, all of which use the same set of communications protocols. Also called the World Wide Web (with the terms are frequently used interchangeably), technically, the internet comprises the physical infrastructure elements. The World Wide Web is software (i.e., the large collection of webpages connected by hyperlinks) and is a service of the internet.

The internet effectively began in 1965, when Lawrence Roberts and Robert Merrill connected two computers via a low-speed telephone line, one in Massachusetts and one in California. By 1969, a better-developed version of the internet, ARPANET, was demonstrated among computers at Stanford University and the University of California at Los Angeles (UCLA). By 1995, or in just under 25 years, 16 million people had begun using the internet. By 2005, a billion users were accessing the internet, and as of 2019, over 4 billion[47]. Today, citizen internet access and usage are considered barometers of the economic development of nations.

As the internet has developed, rapid changes to hardware, software, and networking technologies have increased utility and speed. Networks have moved from telephony-based to high-speed, high-capacity fiber optic cables and wireless. Content has shifted from simple text to the ability to stream dense video, photographic, and music content worldwide. Access has moved from desktop computers to small mobile devices, especially cellular phones. Users may now connect anywhere in the world with but milliseconds of lag from anywhere else.

Technologies in development to extend internet utility include:

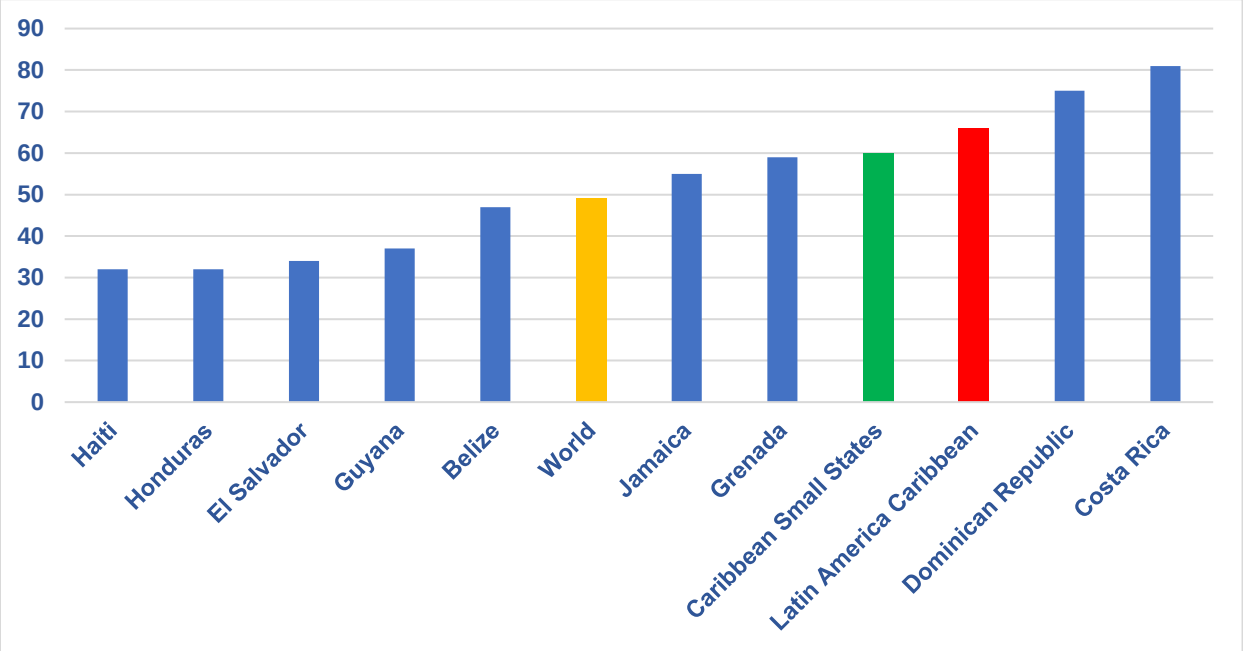
- **5G Data Networks** – super fast data networks allowing better streaming capabilities at lower latency.
- **Internet of Things (IoT)** -- increased bandwidth allows for high-data-intensity new applications such as autonomous driving vehicles, smart machines, and advances in telemedicine, including predictive diagnostics.
- **Computer Vision** – automated, digital visioning.

[47] HootSuite

- **Artificial Intelligence** -- computer system ability to perform tasks previously requiring human intelligence (e.g., visual perception, speech recognition, decision-making, and translation between languages).
- **Virtual and Extended Reality** – used today primarily for entertainment, but also for simulation, training, and other professional uses. The user allows the computer to create a virtual world and block out the real one.
- **Blockchain** – a digital ledger to record transactions secured via encryption and decentralized. Cryptocurrencies are the medium of exchange, including perhaps the best known, Bitcoin, along with others such as Ether (Ethereum), Binance, zCash, Monero, and Facebook's Libra, which is shifting in scope due to regulatory pressure.

Internet usage (i.e., the percent of the population using the internet) in the Central American and Caribbean sub-region varies widely, as shown in Figure 29. Costa Rica and the Dominican Republic are well above the regional and world average for internet usage.

Figure 29: Internet Usage Penetration - 2018[48] (Percent of Population Using the Internet)



A1.1.3 Broadband

Broadband is a high-capacity transmission technique using a wide range of frequencies, enabling a large number of messages or other content to be communicated simultaneously. The term broadband commonly refers to high-speed internet access that is always on and faster than the historical dial-up access. Several high-speed transmission technologies comprise broadband, including:

[48] World Bank

- **Digital Subscriber Line (DSL)** - a wireline transmission technology over traditional copper telephone lines already installed to homes and businesses with transmission speeds ranging from several hundred kilobits per second (Kbps) to millions of bits per second (Mbps).

- **Cable Modem** - broadband provided using the same coaxial cables that deliver pictures and sound to a television. Cable modems are typically external devices with two connections, one to the cable wall outlet, the other to a computer, and operate at transmission speeds of 1.5 Mbps or more. It is possible both to use broadband and watch television simultaneously.

- **Fiber** - converts electrical signals carrying data into light and sends the light through transparent glass fibers about a human hair's diameter. Fiber transmits data at speeds far exceeding current DSL or cable modem speeds, typically by tens or even hundreds of Mbps. Fiber may run to the customer's home or business, the curb outside, or a location somewhere between the provider's facilities and the customer.

- **Wireless** - a radio link between the customer's location and the service provider's facility, either mobile or fixed. Wireless technologies using longer-range directional equipment can provide broadband service in remote or sparsely populated areas where DSL or cable modem service would be costly. Speeds are generally comparable to DSL and cable modem. An external antenna is usually required.

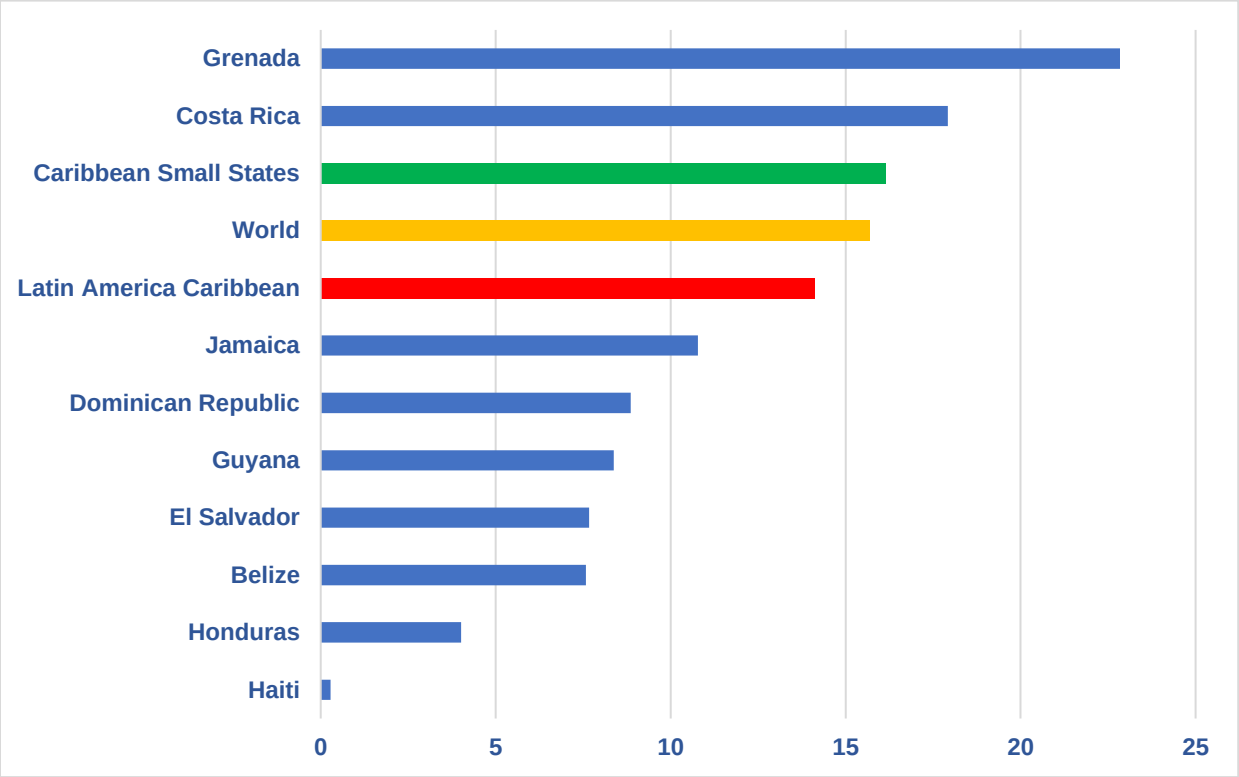
- **Satellite** - satellites orbiting the earth provide vital links for telephone and television service and create wireless links for broadband useful for serving remote or sparsely populated areas. Consumers may expect to receive (download) at 500 Kbps and send (upload) at 80 Kbps. These speeds may be slower than DSL and cable modem, but they are about ten times faster than the download speed with dial-up Internet access. Extreme weather conditions, however, may cause service to be disrupted.

- **Broadband over Powerlines (BPL)** - delivery of broadband over the existing low- and medium-voltage electric power distribution network. BPL speeds are comparable to DSL and cable modem speeds. Power lines are installed virtually everywhere, thus alleviating the need to build new broadband facilities.

Broadband's origins date to the 1960s. By 1969, prestigious colleges on the U.S. east and west coasts had 50Kbps or better broadband connections. In 1984, these colleges adopted T1 (voice and data) lines, forgoing the use of the previous 50Kbps channels. In the early 1990s, businesses began to use broadband, and by 2000-2001, home use was growing rapidly. Since the dawn of the millennium, global citizen access, upload and download speeds, and service consistency and reliability have continued to improve.

The use of fixed broadband per 100 people in the Central America and Caribbean sub-region varies widely, as shown in Figure 30. The smaller Caribbean states are generally slightly above world usage levels. In contrast, many of the larger population Caribbean islands and the Central American countries tend to lag both global and regional usage levels.

Figure 30: Fixed Broadband Subscriptions per 100 People, 2018[49]



New broadband technologies overlap those for telephony and the internet and include implementation of the 5G network and eventual development of a 6G network. Certain futurists are beginning to ask the question as to whether fixed, even fiber-based, broadband may become obsolete in future telecommunications generations with speeds above 1Tbps, assuming wireless technologies can solve issues such as line-of-sight.

A1.2 Terrestrial Communications Network infrastructure - Investment Outlook

The value of global telecommunications services was $1.7 trillion in 2019[50] and is expected to grow at a compound annual growth rate of 5 percent from 2020-2027. Continued increases in demand for consumer wireless telephone services, mobile access, and cloud-based technologies drive demand for high-speed telephone, internet, and broadband connectivity. Despite strong individual consumer demand, the commercial segment recently has accounted for the most growth. Commercial application foci include data reliability and quality, both for customers and internally for videoconferencing, high-security intracompany networks, and corporate calling and texting.

Global internet (web) hosting services reached $61 billion in 2018 and will grow at a compound annual growth rate of over 15 percent through 2026.[51] Growth drivers include expanding

[49] Ibid
[50] Grandview Research
[51] Fortune Business Insights

individual consumer demand for greater access to web-based shopping, household device connectivity, and mobile access.

Global broadband services were valued at $327 billion in 2019 and projected to grow at a compound annual growth rate of nine percent through 2027.[52] The digital transformation of several industry verticals, along with ever-expanding consumer demand and access, is driving growth. While the COVID-19 global pandemic has slowed growth in some sectors, broadband usage for e-learning and digital healthcare has grown rapidly.

Overall, this sector's market size in the Latin American/Caribbean region exceeded $100 billion in 2018. Growth in multichannel and fixed broadband/internet services outpaced that in fixed and mobile telephony, which are more mature technologies.[53]

Following are profiles of the countries that have projects profiled in this Resource Guide.

A1.3 Costa Rica

Mobile telephone providers in Costa Rica include ICE (Instituto Costarricense de Electricidad, the Costa Rican government-run electricity and telecommunications services provider), Movistar (Spain), and America Móvil (Claro of Mexico). 2G, 3G, and 4G technologies currently operate in Costa Rica.

The Costa Rican telecommunications market has witnessed strong growth, which is expected to continue through at least 2025. Urban populations and the rising adoption of mobile phones able to support 3G, 4G, and 5G technologies are driving growth. These technologies will also support the adoption of Internet of Things (IoT) applications connecting with both wired and wireless broadband. The Innovation District T24 project reviewed earlier in this Resource Guide seeks to create a San José technological city based on the 5G rollout.

Nonetheless, there is still some disparity in access to ICT services. The Costa Rican indigenous communities have generally lagged. Improved access is the focus of the Network Rollout of Indigenous Communities project covered earlier in this volume.

Costa Rica expects to disable its major 2G/3G platforms by 2025. By 2029, the country hopes to have the majority of mobile connections using 5G technology. By 2025, the government expects mobile communications to dominate.

In 2020, Costa Rican telecommunications regulator, SUTEL, reported growth in the availability of fiber optic communication lines. In the country of 146 percent, from 78,417 km in mid-2019 to 193,000 km during 2020. Correspondingly, fiber optic internet subscriptions increased by 63 percent.

[52] Grandview Research
[53] S&P Global Market Intelligence

Mobile and fixed broadband speeds in Costa Rica averaged 28.13 and 44.85 for download, 9.93 and 10.68 Mbps for upload, and 29 and 17 milliseconds for latency, respectively, in February 2021. These levels position Costa Rica at 77th and 82nd in the world for mobile and fixed broadband on a speed basis, respectively.[54]

A1.4 Dominican Republic

The Dominican Republic hosts four principal mobile telephone providers: America Móvil (Claro), Orange, S.A. (France), Tricom, and Viva. Claro is the largest and also offers internet and IPTV services. Tricom also operates an HDTV cable network, Telecable Nacional. LTE services are available to the vast majority of the population and mobile. Broadband is developing rapidly.

The imbalanced distribution of telephony services generally reflects income inequalities, with many communities having restricted access. The government has public projects seeking to provide further access. In October 2020, the government issued a decree covering universal access to broadband services and the development of a national backbone network in cooperation with the electricity transmission network provider.

The Dominican Republic's Broadband Plan project reviewed earlier in this Resource Guide supports 5G auctions during 2021, creating telecommunications access to the country's power-transmission fiber optic backbone, and creating a digital terrestrial television map.

Mobile and fixed broadband speeds in the Dominican Republic averaged 28.09 and 27.46 for download, 9.54 and 7.96 Mbps for upload, and 42 and 28 milliseconds for latency, respectively, in February 2021. These levels position the Dominican Republic at 78th and 108th in the world for mobile and fixed broadband on a speed basis, respectively.[55]

A1.5 Haiti

Mobile telephone providers in Haiti include Digicel and Natcom, operating primarily 3G technology. In 2020, the Government gave both providers a one-year exclusivity period to offer LTE services, despite their requested four years. The efforts in promoting LTE and data services such as mobile banking have improved internet connectivity and usage in rural areas where fixed-line infrastructure remains inadequate.

Limited fixed-line infrastructure requires most internet users to rely on satellite and wireless technologies. Natcom has built three international gateways and quadrupled global connectivity since 2011. Broadband services are now more readily available, with Natcom serving as a wholesale provider for the small number of other ISPs in the market.

Haiti still faces barriers to fixed-line broadband development, including income per capita, low device penetration, and a perennial problem of equipment theft. Although Natcom has built a 6,500km fiber backbone, which helps to support growth in the fixed broadband sector, practical challenges mean the majority of users connect via mobile networks. The Haiti Digital Acceleration

[54] SpeedTest https://www.speedtest.net/global-index/costa-rica
[55] Ibid

Project, reviewed earlier in this Resource Guide, will increase access to broadband services and improve digital resilience to respond to natural disasters and other infrastructure shocks in the country.

Mobile and fixed broadband speeds in Haiti averaged 16.25 and 13.40 for download, 10.25 and 12.64 Mbps for upload, and 42 and 28 milliseconds for latency, respectively, in February 2021, positioning Haiti at 125th and 147th in the world mobile and fixed broadband on a speed basis, respectively.[56]

A1.6 Honduras

Honduras is among the most economically challenged countries in Central America and has faced political instability, making telecom sector reform difficult historically. Poor fixed-line infrastructure resulting from topographical challenges and limited government allocations have made investments in rural areas unattractive or uneconomical. As a result, internet usage has been relatively slow to develop. DSL and cable modem technologies are available but expensive. High-speed access tends to be restricted to urban centers. The demand for broadband is steadily increasing, with some recent investments to upgrade fiber-based infrastructure. The San Pedro Sula Smart City Project reviewed earlier in this volume includes establishing additional fiber optic broadband connections in the city and a 5G pilot rollout.

Mobile telephone providers in Honduras include America Móvil (Claro) and Millicom (Tigo). Current service is typically 2G or 3G technology.

Mobile and fixed broadband speeds in Honduras averaged 22.61 and 21.14 for download, 10.57 and 9.55 Mbps for upload, and 38 and 29 milliseconds for latency, respectively, in February 2021. Honduras ranks 92nd and 128th globally for mobile and fixed broadband on a speed basis, respectively.[57]

[56] Ibid
[57] Ibid

A2 Subsea Communications Infrastructure

A2.1 Sector Overview

Subsea (or submarine) fiber optic cables are effectively the backbone of the internet today. They permit countries and continents to share information across long geographic distances. While satellite communications are highly effective, subsea fiber optic cable today is more reliable and cost-effective. In the future, some competition from Low Earth Orbit (LEO) satellites is likely.

Subsea fiber optic cables are laid on the seabed to provide a high-capacity means of transferring large amounts of information and data. Using the seabed for cable laying allows for route shortening and optimization, which reduces transmission lag (latency) and also avoids terrestrial security issues such as natural disasters and human acts such as vandalism.

Subsea cables are designed and manufactured to:

- Be installed underwater and take into account:
  - Ambient temperature (both sea and land);
  - Burial/water depth and associated pressures;
  - Nature of shore approach; and
  - Cable length.
- Be laid on the rugged and rocky seabed, as well as be buried near the shore approach.
- Withstand marine animals, tsunamis, volcanic activity, and trawls used by fishermen.

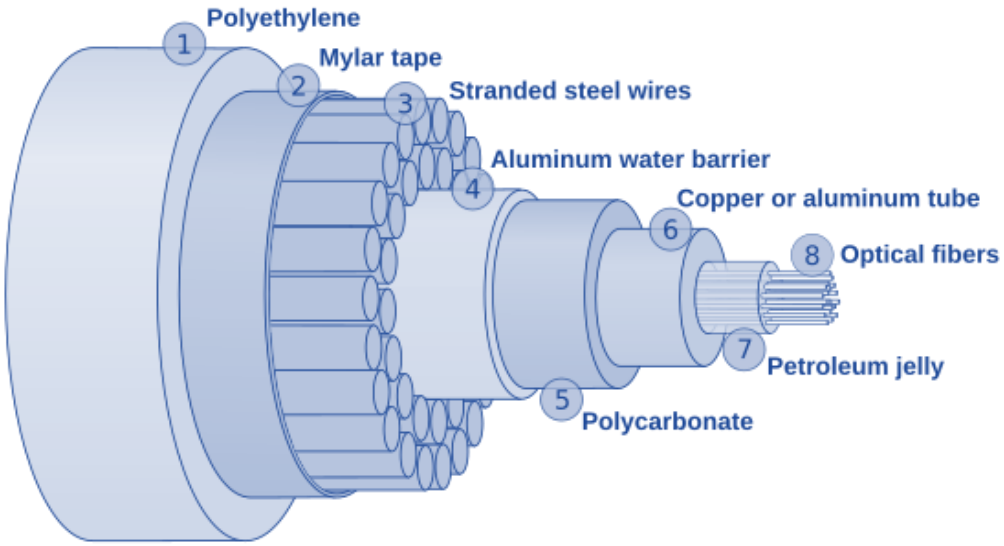
A typical subsea fiber optic cable includes numerous components, of which all but the fibers themselves are protective of the glass optical strands at the center. The optical fibers carry digital data in the form of light, as shown in Figure 31.

Typical subsea fiber optic cables are just under an inch in diameter and weigh 2.5 tons per km. Manufacturers typically add extra armoring for cables and cable ends residing near a shoreline. The optical fibers themselves are about the diameter of a human hair and are fashioned of highly pure glass coated with a high-performance polymer such as a polyimide.

Installers typically bury near-the-shoreline cable sections under the seabed for extra protection. Before installation, route studies assess preferred alternatives to avoid hazards such as fault lines, anchoring zones, fishing areas, etc. The shortest cables, such as Google's Junior, connecting Rio de Janeiro and Santos, Brazil, are but a few hundred km. Transcontinental cables run lengths of as many as ten to twenty thousand km.

A laser, at one end of the cable installation, transmits digital data by firing a light signal down the optical fiber. The data, in the form of the light signal, is captured on the other end by a receptor. The optical fiber performs essentially as a mirror. The laser switches on and off to send each bit. Modern fiber systems with a single laser can transmit billions of bits per second, i.e., the laser can turn on and off several billions of times per second. Newer systems use multiple lasers with different colors to fit numerous signals into the same fiber. Fibers are paired within cables, one fiber for each direction.

Figure 31: Subsea Fiber Optic Communications Cable Construction[58]



Fiber optic cables can carry a signal up to about 60 miles (100 km). On a long-distance line, equipment huts at intervals contain equipment to pick up and retransmit the signal, at full strength, down the next segment.

Redundancy is built into cable systems to reduce the impact of cable faults, typically by spreading network capacity over multiple cables. Other cables manage the function of a cable requiring downtime/repair time until repairs are complete. About two-thirds of cable faults result from marine traffic (fishing and anchor dragging), with environmental issues, such as earthquakes, another major fault contributor. Occasionally underwater components fail.

At the ends of a subsea fiber-optic cable are landing points. Landing points are selected to have silty bottoms to allow the line's burial to protect it from damage, mild currents to ensure the cable's positional stability once buried, and minimal marine traffic. Multiple cables frequently share landing points. A landing station may provide power to subsea amplifiers and repeaters, as well. A cable termination station (which may or may not be the same as the landing station) provides the point at which the subsea cable connects with the high capacity, terrestrial, backhaul system, typically near an area of high communications demand such as major metropolitan areas.

The first subsea fiber optic cable, TAT-8, running between the United States (AT&T), the United Kingdom (British Telecom), and France (France Telecom), was laid in 1988. It was capable of carrying 280 megabits per second (Mbps), the equivalent of 40,000 telephone circuits.

As of 2020, roughly 400 subsea optical fiber cables are operational. The highest capacity subsea fiber optic cables operate at more than 100 terabytes per second (Tbps), more than 10 million times the speed of the typical home internet connection, and the equivalent of carrying 45 million high

[58] Fibertronics, U.S. Patent No. 4,278,835

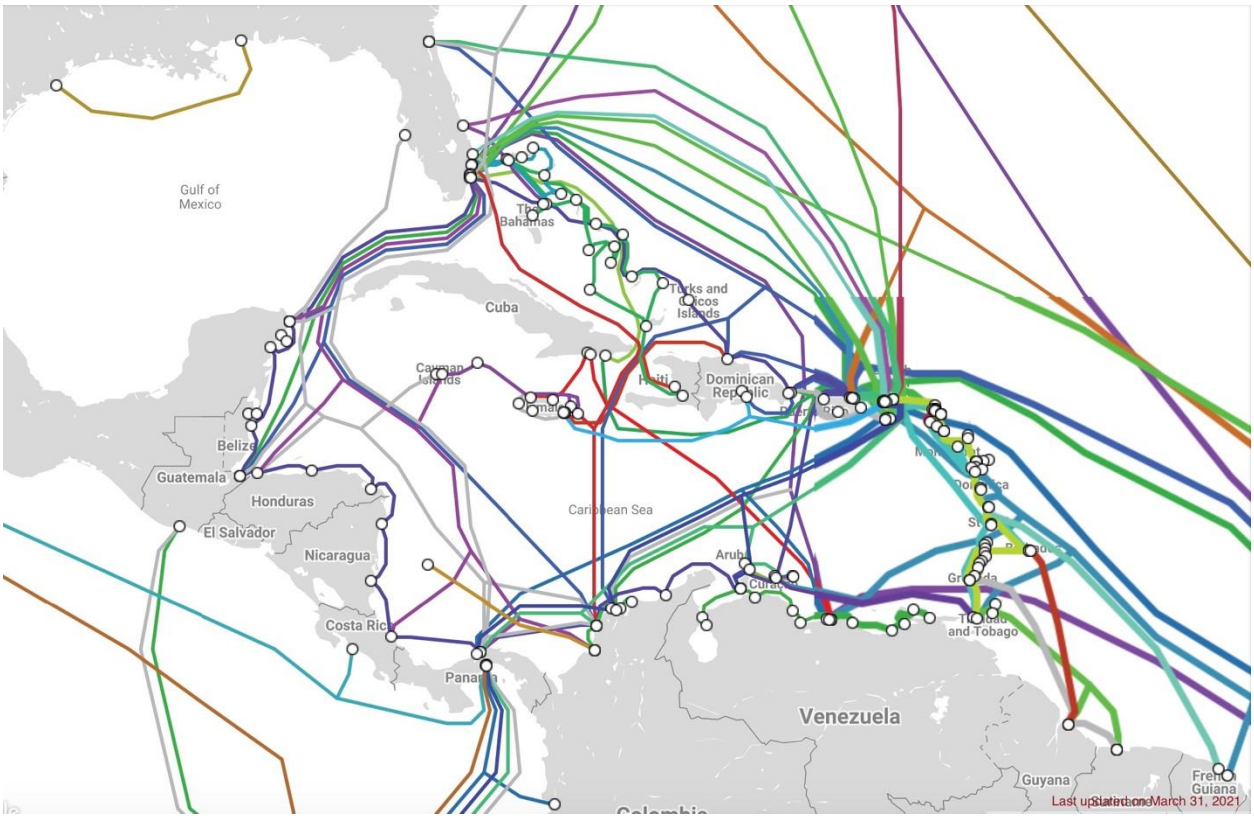
definition videos simultaneously. The Marea cable, connecting the United States (Virginia Beach, VA) and Bilbao, Spain, has a design capacity of 160Tbps but has demonstrated the ability to run at up to 200Tbps.

Recent technology developments include capacity-enhancing spatial digital multiplexing (SDM) and twisted light spirals. Google Global Networking has recently reported adapting the use of existing subsea fiber optic cable technology to detect and provide early warnings for earthquakes and tsunamis.

A2.2 Subsea Communications Infrastructure - Investment Outlook

The Latin American/Caribbean region hosts and has under construction a total of 68 cable systems and 217 landing stations. The Central American and Caribbean sub-region likewise hosts numerous cables and landing stations, as shown in Figure 32. All Central American and Caribbean countries profiled in this Resource Guide have at least one connection to subsea fiber optic telecommunications cables.

Figure 32: Central America and Caribbean Sub-region Subsea Fiber Optic Cable Map[59]



[59] Submarine Cable Map https://www.submarinecablemap.com

The global subsea fiber optic cable market is approximately $14 billion, with a projected growth rate of 13 percent through 2025[60]. Today, the U.S. and China represent a combined 42 percent of the global market, with the Latin American/Caribbean market estimated to represent a 10 percent share, or about $1.4 billion.

While historically, telephony and telecommunications companies owned subsea fiber optic cable systems, increasingly, content providers such as Amazon, Facebook, Google, and Microsoft are emerging as owners and co-developers of new cables. In addition to the numerous ongoing subsea fiber optic cable projects in South America, this creates unique opportunities for U.S. companies to align with U.S. content providers for new cable development in the Central America and Caribbean region, as the Seaborn CARICOM cables will do.

The subsea cable project profile included in this Resource Guide covers the Central America and Caribbean region overall. No individual country reviews follow here. Insights on existing fiber optic cable coverage for the nations profiled in this volume are provided in the Resource Guide's country sections.

A3 Data Centers and Cloud Computing

A3.1 Sector Overview

Data centers and cloud computing are closely interrelated. Data centers provide storage for large amounts of digital information. Cloud computing, simply, is accessing and storing information and programs that do not reside on the computer a user is accessing, but rather via the internet, with the data/programs stored remotely in a data center.

A3.1.1 Data centers

Data centers store and assist in the retrieval and processing of large amounts of critical information. Frequently, a data center houses servers/data storage for a specific organization, though multiple customers share many. A data center includes:

- The building/real estate housing storage;
- Storage hardware (servers);
- Server racks and cabinets;
- Power and operational backup systems;
- Environmental controls, especially cooling;
- Cyber and physical security; and
- Anything else deemed necessary to keep the servers running.

A data center may be as simple as a single server or as complex as hundreds of thousands of servers, as shown in Figure 33. The average data center includes tens of thousands of servers and occupies about 100,000 square feet of space. The largest global data centers are in the range of three to seven million square feet. Most data centers, especially large-scale facilities, are sited to

[60] ReportLinker

avoid natural disasters, thus minimizing downtime risk. Power and cooling are large operational cost contributors, as well as limits to data center scale.

Figure 33: Data center Exterior and Interior[61]

Data centers segment by:

- Type – nature of operations;
- Tier (I-IV) – uptime/downtime/redundancy;
- Density – low, medium, high, and extreme;
- Vertical served – e.g., government, telecom and IT, banking and finance, healthcare; and
- Nature of infrastructure – types of electrical, mechanical, and IT systems incorporated.

Data centers types include:

1. **Hyperscale** – typically owned and operated by the company it supports. Hyperscale data centers offer a portfolio of scalable applications and storage to third-party individual and corporate customers. These data centers are typically high-square-footage, high-server-count locations distinguished by an ultra-high-speed, high fiber-count, fiber-optic network. Participants in this sector include AWS (an Amazon subsidiary), Microsoft, Google, and Apple.

2. **Colocation/Wholesale Colocation** – these data centers are typically single-owner sites, where the owner sells or leases space, power, and cooling to other enterprises or hyperscale customers in a specific location. Typical colocation data centers typically service hundreds to thousands of customers. In addition to basic data center capabilities, these facilities often provide technical guidance and, importantly, interconnection services to Software as a Service (SaaS – e.g., Salesforce) and Platform as a Service (PaaS – e.g., Azure) to assist their customers in scaling their businesses with low cost and complexity. Wholesale Colocation data centers typically do not offer Interconnection Services. They tend to service fewer customers than average, as they typically focus on location-specific infrastructure provision for sophisticated enterprise and hyperscale clients.

[61] Amazon Web Services, JAYCor International

3. **Enterprise** – an enterprise data center is owned and operated by the company/entity it supports, often at the location of existing company operations. Owners may divide enterprise data centers to host the needs of various businesses within the company's portfolio. Mechanical and electrical services are often outsourced, but the company typically runs the white space (data center operations) itself. Enterprise data centers usually comprise at least ten server cabinets (several hundred servers) but may be much larger.

4. **Telecom** – a telecom data center is owned and operated by a telecommunications or telecom services provider (e.g., AT&T, Verizon, *et al.*) and requires unusually high levels of connectivity and reliability. Telecom data centers are responsible for driving content delivery, mobile services, and cloud services. They may be "lights out" (i.e., physically or geographically isolated) to minimize environmental and human contact and ensure uptime.

5. **Edge** – these are the newest type of data center and are in the early stages of development. Edge data centers will support the Internet of Things (IoT), autonomous vehicles, and other data-intense applications for which content placement close to the user is desirable. Likely to be powered by 5G communications networks to support high data transport requirements and minimize latency, their development will require considerable optical fiber hardware and fiber optics installations. Key characteristics include:

    - *Local* – placed near areas served but managed remotely;
    - *Small* – same components as a traditional data center but a smaller-than-typical footprint;
    - *Fractional* – one of many in a larger, complex network that includes a central enterprise or hyperscale data center; and
    - *Mission-critical* – bringing computation and data storage closer to the location where required, improving response times, saving bandwidth, and minimizing latency.

Also, data centers are typically segmented by tiers, defining their annual uptime availability, maximum downtime, redundancy of power paths, and ability to withstand force majeure events, as shown in Table 32.

Table 32: Data center Tiers[62]

Tier	User Group	Uptime (%)	Annual Downtime (hours)	Power Outage Protection (hours)
1	Small Businesses	99.671	28.8	No redundancy
2	Medium-size Businesses	99.749	22.0	Partial redundancy
3	Large Businesses	99.962	1.6	72
4	Enterprise Corporations	99.995	0.4	96

Technology is changing rapidly in this sector with the development of artificial intelligence (AI), edge and server-less computing, and SaaS (software-as-a-service/online subscription models), all

[62] ComRent/The Aberdeen Group

of which move away from historic data centralization. Satellite operator Starlink (part of Elon Musk's SpaceX), which is launching hundreds of Low Earth Orbit (LEO) satellites to provide global broadband coverage (especially to difficult to reach locations), even envisions the addition of extraterrestrial data centers to support its extraterrestrial broadband network.

A3.1.2 Cloud Computing

Cloud computing, in simplest terms, is storing and accessing data and programs over the internet instead of on one's own computer hard drive. More broadly, Cloud computing is a process of delivering and enabling scalable, expandable, almost perfectly elastic software services using internet technologies. Typically provided through a third-party vendor with its own data centers, cloud computing is a means of delivering Software as a Service (SaaS) on a pay-per-use or pay-per-time period basis. Cloud computing provides self-service capabilities with scalable features to users, allowing increased capacity upon requirement. Typical service offerings of cloud computing providers include Infrastructure (IaaS), Platform (PaaS), and Software (SaaS) as a Service, as well as Backend as a Service (BaaS), which is similar to SaaS except directed toward developers, whereas SaaS is directed toward users. In each approach, the user company manages certain functions, and the Cloud Services provider handles others, as shown in Table 33.

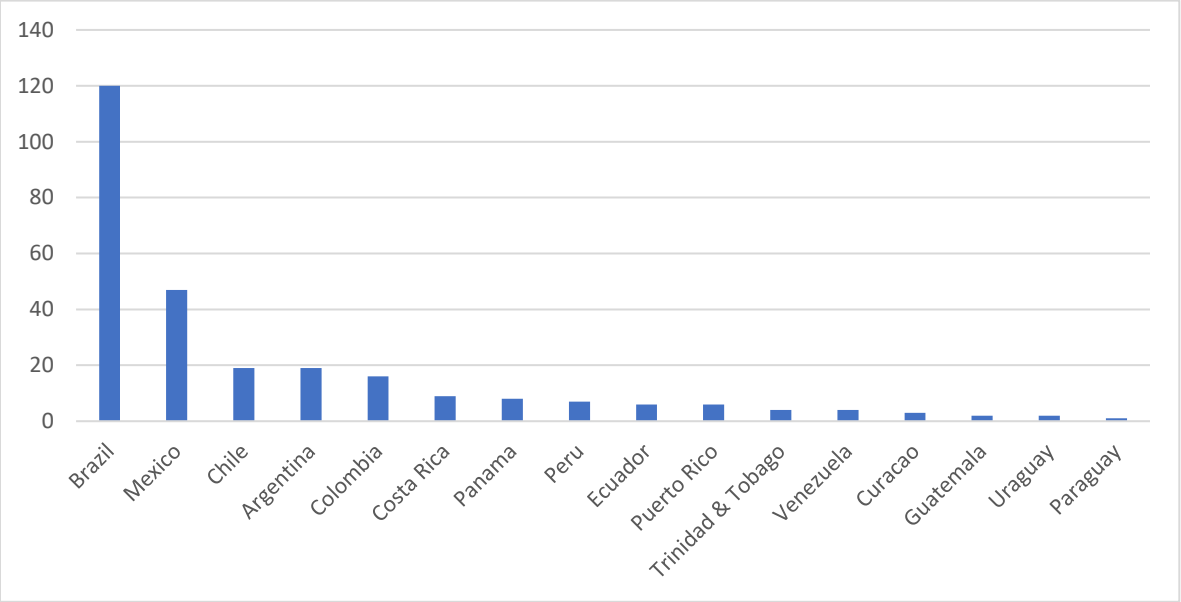
Table 33: Cloud Computing Activities by "As a Service" Type[63]

Separation of Responsibilities – "As a Service " (aaS) Formats			
On Premises	**Infrastructure (IaaS)**	**Platform (PaaS)**	**Software (SaaS)**
Applications	Applications	Applications	Applications
Data	Data	Data	Data
Runtime	Runtime	Runtime	Runtime
Middleware	Middleware	Middleware	Middleware
O/S	O/S	O/S	O/S
Virtualization	Virtualization	Virtualization	Virtualization
Servers	Servers	Servers	Servers
Storage	Storage	Storage	Storage
Networking	Networking	Networking	Networking

Data center (and cloud computing) presence varies widely within countries in the Latin American/ Caribbean region, as shown in Figure 34.

[63] Assist Software

Figure 34: Number of Latin American/Caribbean Region Data centers by Country[64]



A3.2 Data centers / Cloud Computing Investment Outlook

The global data center business is $135 billion globally, with projected compound average annual growth rate (CAGR) estimates ranging from five to ten percent through 2023. The Latin American/Caribbean data center business is approximately five percent of the world total and is projected to grow slightly faster than the global rate. Demand for new regional data centers is driven by government initiatives toward modernization/infrastructure development and employment and the growth of private enterprise.

While several large U.S. players, including AWS (operating in São Paulo since 2011 and currently planning a large expansion there, as well as in Argentina), Microsoft, IBM (operating in São Paulo since 2005), and Equinix are present in Brazil, none operate yet in the Central America and Caribbean sub-region.

The global market for cloud computing is approximately $15 billion, with a CAGR of 19 percent through 2027.[65] Today, the United States is the largest cloud computing market, representing about one-third of global demand. The Latin American/Caribbean region represents about 10 percent of the global market currently. This region is projected to grow at a CAGR of over 25 percent from 2020 to 2027 (not accounting for likely development lags resulting from the 2020 COVID-19 global pandemic).

Several large U.S. cloud-computing players, including Cisco, Hewlett Packard, IBM, and Microsoft (Azure), are operationally present in South America.

Following is the profile for Honduras, where one project is profiled.

[64] Cloudscene and Data centermap
[65] Report Linker

A3.3 Honduras

Honduras currently hosts approximately nine data centers, seven colocations and two dedicated. Seven data centers are in Tegucigalpa, with another two in San Pedro Sula. Principal colocation service providers include Navegalo, Millicom (Tigo), and Ufinet. In Tegucigalpa, two banks operate their own data centers: the Banco Central de Honduras (BCH), which hosts its Centro do Computo Primario, and BAC Credomatic. Today, Honduras ranks 72nd globally in terms of data center density.[66] The San Pedro Sula Smart City Project described in the Honduras section of this Resource Guide includes a new municipal data center.

A4 Smart Cities and e-Government

A4.1 Sector Overview

A smart city is a municipality incorporating information and communications technologies (ICT) to improve efficiency, quality, and urban services performance. The ICT tools aid in reducing resource consumption, waste, and overall costs and improving service quality, responsiveness, and transparency. Frequently, ICT smart-city tools also provide direct service access and government and community participation to residents.

Typically, more than half of smart-city services are delivered through the public sector. Smart cities and e-Government are closely related. e-Government (short for electronic government) is the use of ICT networks and devices to provide public services to citizens and other persons residing in a country, region, or municipality. e-Government offers opportunities for more direct and convenient citizen access to government overall, government transparency, and direct provision of government services.

A4.1.1 Smart Cities

A smart city is a highly digitally connected municipality using information and communications technologies to increase operational efficiency, share information with the public, and improve both the quality of government services and associated citizen welfare. Initiatives typically focus first on infrastructure development, such as reliable electric supply, robust IT digitization and connectivity, and efficient public transportation. Efforts surrounding citizen safety and security, public housing, healthcare, education, and traffic and transportation management, as well as government efficiency and transparency, may be added (*Figure 35*).

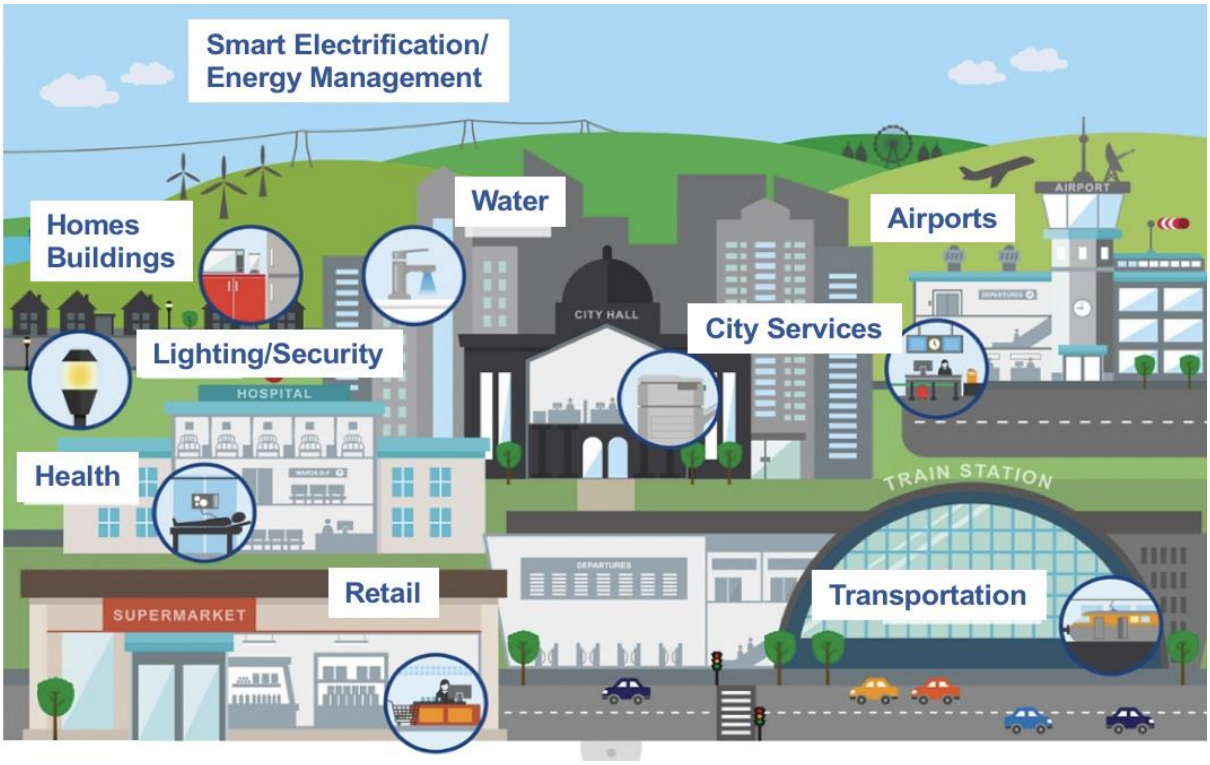
Today, cities are home to more than half the world's population.[67] The United Nations projects that by 2050, 68 percent of the global population will reside in cities. By 2035, 600 cities will account for approximately 65 percent of global GDP.[68] The continued population migration to cities will require new, personalized, and interactive municipal services, many delivered under the

[66] Cloudscene https://cloudscene.com/market/honduras/all
[67] McKinsey & Company
[68] Ibid

smart cities umbrella. For example, in a pilot of three cities, McKinsey and Company found smart cities tools could produce the following results:

- Reduce fatalities by 8–10 percent;
- Accelerate emergency response times by 20–35 percent;
- Reduce the average commute by 15–20 percent;
- Reduce disease burden by 8–15 percent;
- Reduce greenhouse gas emissions by 10–15 percent; and
- Reduce water consumption per citizen by 25-80 liters per day.

Figure 35: Smart City ICT Applications[69]



Numerous entities rank smart cities annually. Today, top-ranked global smart cities are located in North America and Western Europe primarily, with Singapore routinely included. In general, wealthier urban areas are faster to transform, though Asia, with large populations of younger citizens, has also rapidly embraced the smart cities concept (*Table 24*).

Lack of sufficient ICT infrastructure has posed challenges to smart city development in certain geographies. In some, such as Asia and the Middle East, initiatives are in development to create new cities that will be smart from the start. Perhaps the most notable "new city" initiative is the development of the new Indonesian capital on the island of Borneo.

In the Latin America Caribbean region, the National Autonomous University of Mexico, with its over 350,000 students, is developing a smart education and supporting local services hub. São

[69] International Electrotechnical Commission

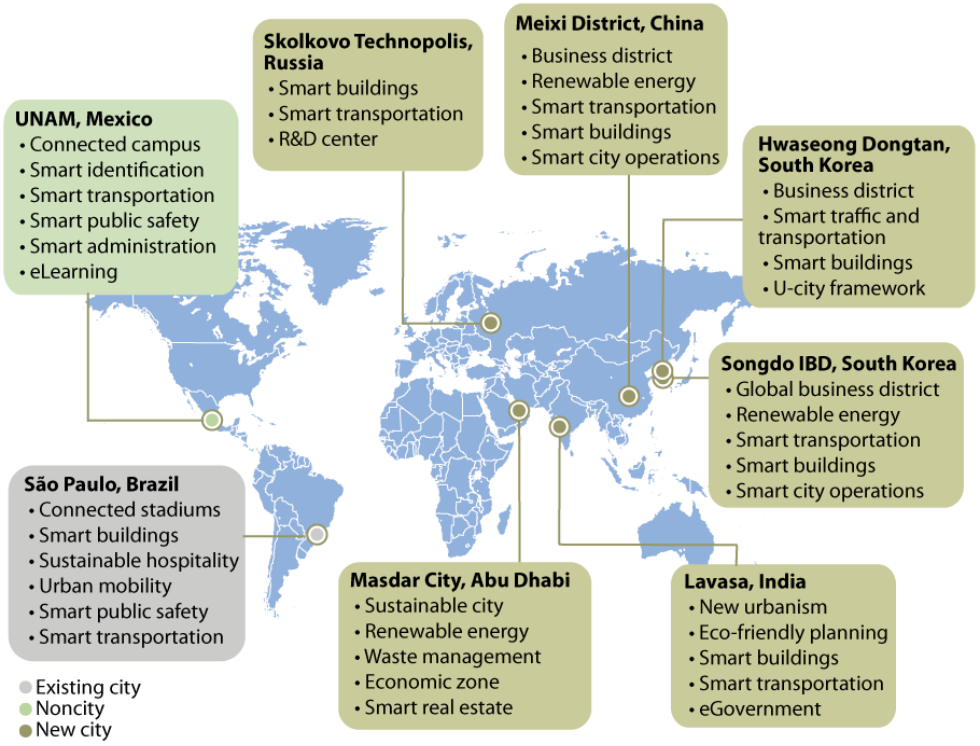
Paulo has been at the forefront of adopting smart city practices in Brazil (*Figure 34*). Numerous additional Latin American examples are provided in the project reviews in this Resource Guide.

Table 34: Top 40 Global Smart Cities, 2019[70]

Rank	City	Comment
1	London	#1 – Human Capital, #3 – Transportation (behind Shanghai and Beijing – outside top 50), #1 – International Outreach
2	New York	#3 – Human Capital, #1 – Economy, #2 – Urban Planning
3	Amsterdam	#2 – International Outreach
4	Paris	#3 – International Outreach
5	Reykjavik	#1 – Environment
6	Tokyo	#3 – Economy
7	Singapore	#1 – Technology
8	Copenhagen	#3 – Environment
9	Berlin	
10	Vienna	
11	Hong Kong	#2 – Technology
12	Seoul	
13	Stockholm	
14	Oslo	
15	Zurich	#1 – Social Cohesion
16	Los Angeles	#2 – Human Capital, #2 – Economy
17	Chicago	
18	Sydney	
19	Melbourne	
20	San Francisco	#3 – Technology
21	Helsinki	
22	Washington D.C.	
23	Madrid	
24	Boston	
25	Wellington	#2 – Environment
26	Munich	
27	Barcelona	
28	Basel	
29	Taipei	#3 – Social Cohesion, #3 – Governance
30	Berne	#2 – Social Cohesion, #1 – Governance
31	Barcelona	
32	Geneva	#2 – Governance
33	Frankfurt	
34	Hamburg	
35	Auckland	
36	Gothenburg	
37	Dublin	
38	Montreal	
39	Ottawa	
40	Miami	

[70] IESE Cities in Motion Index

Figure 36: Smart City Development Examples Outside North America and Western Europe[71]



Three technology-related layers combine to create a functioning smart city:

1. **Technology base** – including a mass of cell phones and other sensors connected by a high-speed, high-capacity communications network with open data portals;
2. **Applications** – specific programs and digital tools for key functions including economic development, energy, health, housing, mobility, security, waste, water, and engagement/community; and
3. **Public usage** – applications, and the smart city as a whole, rely on broad adoption and resulting changes in citizen behaviors. Applications giving citizens greater transparency and allowing them to optimize their choices generate wide adoption.

More than 80 percent of the Latin American and Caribbean population lives in cities; however, 27 percent of the urban population lives in informal settlements without access to basic services.[72] Digitization is far from uniform and frequently unevenly distributed.

Nonetheless, in the Latin America and Caribbean region, numerous municipalities are already implementing smart city initiatives, and several rank among high and medium performers in the IESE Cities in Motion (Smart Cities) Index of 174 global cities:

- Santiago, Chile (66 - High);

[71] Forrester Research
[72] Inter-American Development Bank

- Buenos Aires, Argentina (77 - Medium);
- Montevideo, Uruguay (92 - Medium);
- San José, Costa. Rica (112 - Medium);
- Panama City, Panama (114 – Medium); and
- Bogotá, Colombia (117 - Medium).

Latin America and Caribbean cities considered in the IESE rankings are highlighted below (*Figure 37).* Of the Central America and Caribbean sub-region, only Costa Rica and the Dominican Republic are included in the IESE, though several other nations have smart cities programs, many earlier in the scope of their development.

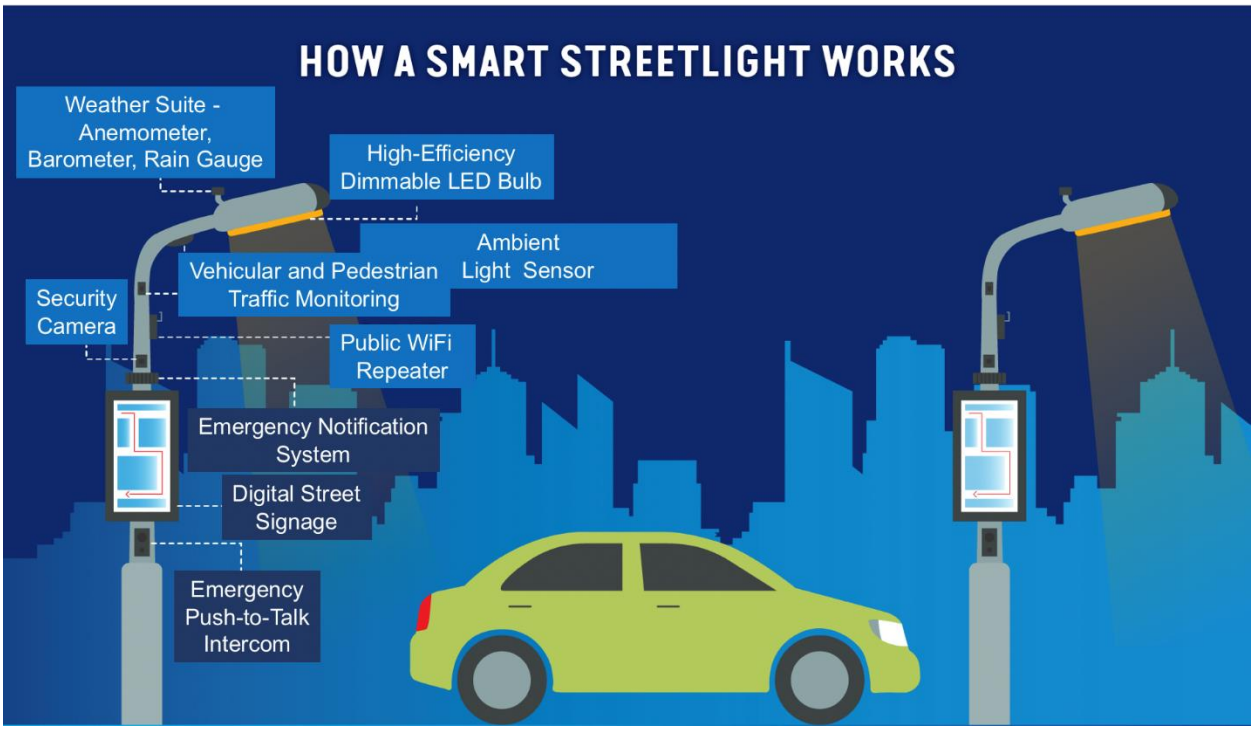
Figure 37: Latin American and Caribbean Cities Considered In IESE Cities in Motion (Smart Cities) Index[73]

[73] IESE

A4.1.2 Smart Street Lighting

One of the early programs typically undertaken on the path toward creating a smart city is smart street lighting. Smart streetlights are networked, intelligent lighting systems consisting of smart lamp posts, LED luminaires, sensors, communication modules, and other peripheral devices. Smart streetlights improve safety, manage municipal energy consumption, and frequently provide both citizen and municipal access to warning and communication features highlighting crimes in progress, as well as impending weather events and natural disasters. Smart street lighting poles may provide public Wi-Fi access and device charging (*Figure 38*).

Figure 38: Smart Street Lighting Features[74]



A4.1.3 e-Government

e-Government applies information and communications technologies, like high speed/high volume communications networks, the internet, and various apps, to enhance government activities, streamline processes, and generate citizen use and interest. These changes serve to increase government efficiency, transparency, and citizen involvement.

At the national/federal level, the Division of Public Administration and Development Management (DPAPM) of the United Nations Department of Economic and Social Affairs (UN-DESA) conducts a bi-annual e-Government survey, including an *e-Government Development Index (EGDI)*. It is a comparative ranking of 193 countries of the world using three indicators:

[74] Coolfire Solutions

1. An Online Service Index (OSI) measuring the online presence of the government in terms of service delivery;
2. A Telecommunication Infrastructure Index (TII); and
3. A Human Capital Index (HCI).

The Survey assesses the UN's 193 member states according to a quantitative composite index of e-Government readiness based on website assessment, telecommunications infrastructure, and human resources capabilities. The TII, which focuses on ICT availability, considers internet access, fixed and mobile telephone subscriptions, and fixed and wireless broadband availability.

As is the case for smart cities, the top scorers in the EGDI are typically high-income-level countries, including West European nations, the United States, Singapore, South Korea, Australia, and New Zealand.

Uruguay is the only Latin American country with a "very high" EGDI score (34th globally), though Chile, Argentina, and Brazil each fall just shy of this level (*Table 35*). As a whole, Latin America and the Caribbean showed the largest regional improvement globally between the UN's 2016 and 2018 surveys. Across the Americas, the United States stands at 11th in the world, with Canada ranking as 23rd.

Table 35: The United Nations EGDI Top Ten Americas Countries in e-Government[75]

2018 Americas Rank	Country	EGDI	EGDI Level	2018 Global Rank
1	United States of America	0.8769	Very High	11
2	Canada	0.8258	Very High	23
3	Uruguay	0.7858	Very High	34
4	Chile	0.7350	High	42
5	Argentina	0.7335	High	43
6	Brazil	0.7327	High	44
7	Barbados	0.7229	High	46
8	Costa Rica	0.7004	High	56
9	Colombia	0.6871	High	61
10	Mexico	0.6818	High	64

A4.1.3 Payment Systems

Digital payment systems are used by all government levels (national, state, and municipal) to increase revenue collection, exceed constituent expectations, and improve cash flow. Not only do these ICT systems improve payment and collections efficiency and accuracy in normal times, but during the COVID-19 global pandemic, they allowed citizens to access government services while in quarantine or social distancing. Contactless digital payments at the point of collection, powered

[75] United Nations

by facial recognition, Quick Response (QR) codes, or near-field communications (NFC), can make it less likely for the virus to spread to others through cash exchanges. Online payments have helped to put government stimulus funds into consumers' hands more rapidly across the globe.

In the Latin American and Caribbean region overall, while online identification and authentication systems are fairly robust several challenges exist to broader deployment of digital financial systems (DFS):[76]

- Boosting financial inclusion across populations regardless of income levels and geographic location;
- The ability of regulatory agencies to respond to evolving DFS deployment;
- Infrastructure development;
- Management of the rural/urban population divide; and
- Population readiness in areas where digital literacy is low and trust is high in cash-based transactions.

In terms of usage levels, e-commerce and the DFS ecosystem still reach a relatively small portion of the population in Central American and Caribbean countries, and digital wallets today are a small market niche. Limited levels of physical infrastructure, needed regulatory reforms, and the high percentage of people outside the formal labor market remain barriers to the more widespread adoption of DFS. In many markets, there are disconnects between comparatively high levels of smartphone ownership and low levels of m-commerce, and between increasingly mature identification and authentication systems and remaining issues with security and safety.

Nonetheless, the region is showing strong evidence of innovation and adoption. A group of Eastern Caribbean States introduced a new blockchain currency on March 31, 2021 (see Section A4.10 following), and five of the projects profiled herein include digital payment systems and other DFS technologies.

A4.2 Smart Cities and e-Government - Investment Outlook

The global Smart Cities business opportunity is estimated at $2 trillion by 2025[77], with the Latin American/Caribbean region representing roughly 10 percent of the total. Growth will arise from a global base of about $1 trillion today, although estimates vary widely. The anticipated compound annual growth (CAGR) is 15 percent. The development of Latin American/Caribbean smart cities currently lags other regions such as Asia, North America, and Europe, but numerous programs are either in process or planned. Estimates suggest that globally, circa 70 percent ownership of smart-cities applications by the public sector, with 60 percent of required initial investment arising from the private sector.[78] In addition to the bricks and mortar and associated services required for developing new buildings and housing developments, a wide range of ICTs will be critical to smart city development and e-Government, including:

- 5G and other telecommunications infrastructure and services;

[76] AFI Global https://www.afi-global.org/sites/default/files/publications/2019-07/AFI_FILAC_SP_AW_digital.pdf
[77] Frost & Sullivan
[78] McKinsey and Company

- Voice assistants;
- Artificial Intelligence (AI);
- Internet of Things (IoT);
- Building automation;
- Sensors;
- Big data;
- Cloud computing;
- Cleantech;
- Distributed energy generation;
- Cybersecurity;
- Surveillance;
- Electric and autonomous vehicles (EV and AV) sensors; and
- Advanced driver assistance systems (ADAS).

The global ICT investment in e-Government was approximately $600 to 700 billion in 2019.[79] Communication and IT services represent about two-thirds of investments, while software, devices, and data centers comprise the remaining third. Big Data, the Internet of Things (IoT), and customized apps continue to be new technology focal points for investment.

Following are profiles of the countries that have projects profiled in this Resource Guide.

A4.3 Costa Rica

Costa Rica is one of two Central America and Caribbean sub-region nations (the other being Barbados) to rank high in the United Nations e-Government development index. The country ranks eighth in the Americas and 46th in the world. San José, Cordoba, and Rosario, along with Guatemala City and Panama City, are the only sub-region cities recognized in the IESE Cities in Motion (Smart Cities) Index. Aiding Costa Rica's rapid ICT development are its high levels of mobile telephone, internet, and broadband access.

e-Government support in Costa Rica includes:

- A payment portal;
- e-Procurement capabilities;
- Personal identification services;
- A digital signature system;
- A national registry;
- A social security information service; and
- e-Health services.

Costa Rican smart city applications include smart street lighting and various security and cybersecurity applications.

[79] Grandview Research

Two Costa Rican Smart City and e-Government projects are detailed in this Resource guide:

- E-Government - Costa Rica Fiscal Management Improvement Project: the project will improve the efficiency, effectiveness, and client orientation of tax and customs administration and public expenditure management.
- Smart Cities - Innovation district T24: project combines urban redevelopment with San José's first 5G network rollout to create a technological city focusing on attracting companies and ventures in four areas:
  - Artificial intelligence;
  - Value-added services including big data;
  - Creative industries based on computing; and
  - Life sciences.

A4.4 El Salvador

El Salvador has undertaken numerous smart city projects, particularly in smart street lighting, since roughly 2010, including in San Salvador and San Miguel. The 2019 elected president, Nayib Bukele, has promised e-Government developments during his tenure and has been an active user of social media.

The El Salvador Digital Agenda (reviewed in detail in the El Salvador country section of this report) is one such. Project. The Digital Agenda is intended to integrate ICT actions as an essential part of the country's economic and social development. The project comprises four components:

- Digital Identity;
- Innovation, Education, and Competitiveness;
- Modernization of the State; and
- Digital Governance.

The Highway Lighting PPP Pipeline in El Salvador project (also reviewed earlier here) will install smart street lighting and video surveillance equipment on over 700 km of roads and highways structure to enhance citizen safety.

A4.5 Grenada

Grenada is aiming to become the first "smart small state" through a variety of projects. For example, the country is working with the New York University Marron Institute of Urban Management to define nine projects to enhance its sustainability. While these projects are targeted at climate change, several will have smart cities and e-Government content, and associated ICT technologies. Applications including weather and sea-level monitoring, energy-efficient public lighting, and upgrading home appliances to include IoT to enhance operational efficiency are among the several prospective smart cities and e-Government developments.

Closer to fruition is the Grenada Digital Governance for Resilience project covered earlier in this Resource Guide. This project aims to reduce the time spent on tax-related interactions and streamline transactions through a new digital civil registry system.

A4.6 Guyana

Guyana is undertaking the development of a far-reaching digital governance roadmap as described in the Guyana digital Governance project profile earlier in this volume. The initiative has six objectives:

1. Improve the delivery of government services to the citizenry using an ICT-enabled environment;
2. Reduce digital exclusion;
3. Increase citizen digital participation in good governance, transparency, accountability, democracy, and sustainable development;
4. Implement a well-regulated computing environment for the Government of Guyana;
5. Adopt and promote environmentally sustainable ICT practices within the public sector; and
6. Implement a "whole of government" ICT approach for interoperability among agencies.

In Georgetown, Guyana has piloted smart security and surveillance cameras with digital and license plate recognition. The country expects this initiative to roll out further to combat crime in the country.

A4.7 Haiti

Haiti began its smart cities journey as early as 2012 with the installation of small, smart street lighting initiatives in Port-au-Prince. Numerous opportunities for applying ICT technologies, including digital birth certificates, ease of school registration, and ability to vote, have been considered, although mobile telephone, internet, and broadband access are lowest in Haiti of the countries considered in this Resource Guide.

Nonetheless, the Haiti Digital Acceleration Project (see project profile in the Haiti country section of this Resource Guide) will increase broadband services and improve the resilience of digital capabilities to external shocks such as hurricanes and earthquakes. In addition to capacity building, the project will develop data governance and cybersecurity strategies.

A4.8 Honduras

Honduran President Juan Orlando Hernandez, in 2020, expressed interest with select world leaders in expanding the country's e-Government initiatives, including electric vehicles. The current administration is likely to push for a significant transition to digital phases of government work.

At the municipal level, the San Pedro Sula Technology District and Smart City Pilot (see Honduras country section of this Resource guide for the project profile) will create a smart city control center, along with a pilot 5G rollout, greater fiber optic broadband capability and a new data center in the second-largest Honduran city. The project will also develop spaces for education and technology learning programs and incubators for training and support of entrepreneurial companies.

Group Karims, a Honduran textile and real estate development company, is creating two private sector "smart cities," one in Tegucigalpa and another in San Pedro Sula. These mixed-use

developments feature modern ICT technology access and support. The Tegucigalpa site includes business towers, Unitec University, a corporate and diplomatic zone, and retail and residential spaces. The San Pedro Sula site targets call centers, and business process, and IT outsourcing (BPO and ITO, respectively).

A4.9 Jamaica

Jamaica began its transition to e-Government as early as 2013, using ICT technology to improve service delivery in the public sector. Early projects included the development of a government-wide area network (WAN) and selected digital revenue functions. The country has also implemented systems to target and track crime.

The Jamaica Public Service (JPS) Smart City Project will combine a nationwide smart LED street light deployment with expanded smart meter technology and investment in RF telecommunication infrastructure, providing real-time information for both systems. USTDA is providing a grant to JPS to support the preparation of a Smart City Roadmap, initially as a demonstration effort in the New Kingston area of Kingston, Jamaica. A detailed project profile is provided in the Jamaica country section of this Resource guide.

A4.10 Organization of Eastern Caribbean States (OECS)

The Eastern Caribbean states are moving quickly to adopt e-Government and digital payment systems. For example, the Organization of Eastern Caribbean States is undertaking a broad Caribbean Digital Transformation e-Government project spanning Dominica, Grenada, St. Lucia, and St. Vincent and the Grenadines. The project (profiles in the OECS country section of this Resource Guide) will:

- Create a digital enabling environment;
- Provide digital government infrastructure, platforms, and services;
- Develop digital skills in the population and encourage technology adoption; and
- Oversee project implementation support for electronic payment platforms, efficiency gains in tax collection, and digital public services delivery.

In the payment systems space, the Eastern Caribbean has created its own form of digital currency to help speed transactions and serve people without bank accounts. The Eastern Caribbean Central Bank's "DCash" is the first such blockchain-based currency introduced by any of the world's currency unions, though some individual nations have similar existing systems. DCash became available on March 31, 2021, under a yearlong pilot program in four island nations: St. Lucia, Grenada, Antigua and Barbuda, and St. Kitts and Nevis.

Barbados-based fintech company Bitt, in partnership with the central bank, created DCash. Unlike cryptocurrencies, it is issued by an official central bank and has a fixed value, tied to the existing Eastern Caribbean dollar used across much of the region. The system allows users who have smartphones but not necessarily bank accounts to use an app to make payments via a QR code. There are limits on the amount of money people can send via DCash, and there are no current plans for integrating credit cards. Further, interest does not apply to the digital currency.

A5 Internet of Things (IoT) and Artificial Intelligence (AI)

A5.1 Sector Overview

The Internet of Things (IoT) and Artificial Intelligence (AI) are closely related. IoT is the networking capability allowing information to be sent to and received from objects and devices (such as home appliances, industrial systems, and modes of transportation) using the Internet. AI is the capability of a machine to imitate intelligent human behavior. AI is often incorporated in IoT applications to enhance performance and better predict user needs.

A5.1.1 The Internet of Things (IoT)

The IoT is a system of interrelated computing devices, mechanical and digital machines, objects, animals, or people provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. A *"Thing"* may be an automobile with sensors monitoring/adjusting performance systems; a person with an electronic implant such as a pacemaker; livestock/individual animals with a biochip transponder; a manufacturing plant or piece of equipment with smart sensors; or any other natural or human-made object which may be assigned an Internet Protocol (IP) address and can transfer data over a network.

IoT ecosystems comprise web-capable smart devices using embedded processors, sensors, cameras, and communication hardware to collect, send, and act on data acquired from their environments. IoT devices share the sensor data collected by connecting to an IoT gateway or other edge device and send it to the cloud for processing (or sometimes local analysis). IoT devices generally operate without human intervention. However, humans do interact with the devices for set up, instruction, and access to information resulting from machine data analysis (*Figure 39*). IoT devices frequently communicate with other related devices and act on the information obtained from one another. IoT devices can also use artificial intelligence (AI) and machine learning to make data collection and analysis processes easier and more dynamic.

IoT benefits include:

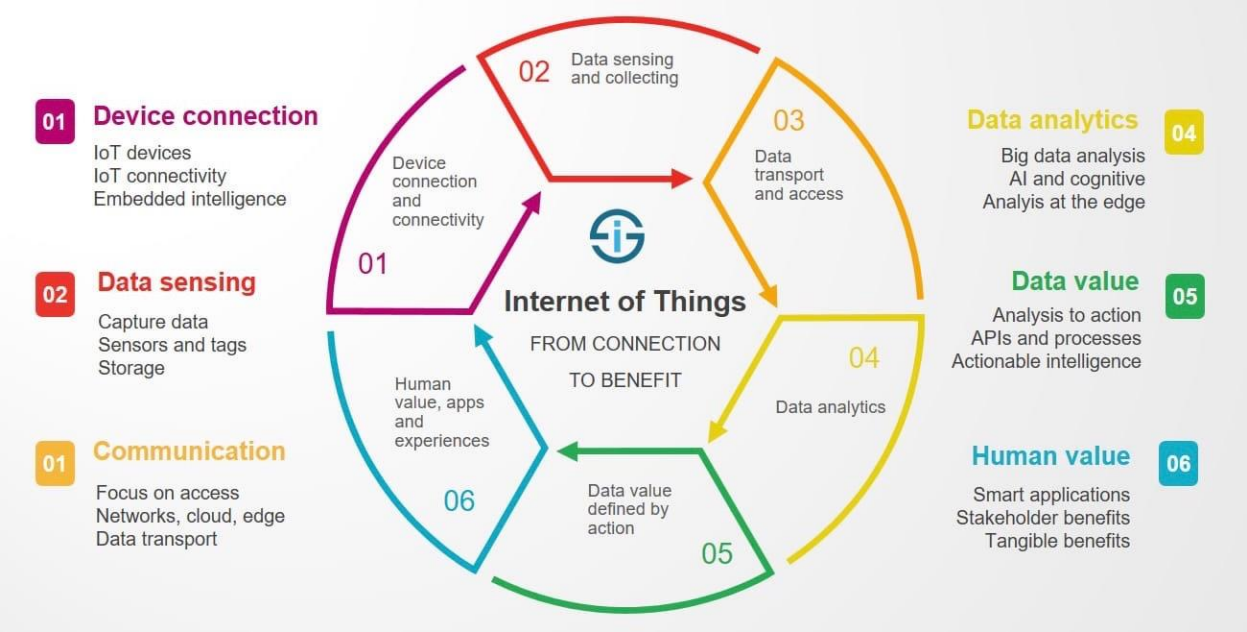
- Access to information from anywhere at any time on any device;
- Improved communication among connected devices; and
- Task automation, improving business, consumer, and production process efficiency, while also reducing human intervention and required labor.

Challenges to wide IoT adoption include:

- The need for a uniform international standard of compatibility for IoT, lack of which currently limits the abilities of devices from different manufacturers and regions to communicate with each other;
- The ability of enterprises to manage with massive numbers of interconnected IoT devices (up to and. including in the millions) and the associated challenges in collecting and managing extensive quantities of data;

- The possibility all interconnected devices will become corrupted if a bug manifests in one; and
- The potential that hackers may steal confidential information, particularly as the number of connected devices increases and more information is shared among devices.

Figure 39: Internet of Things (IoT) Data and Benefit Cycle [80]



IoT uses span numerous markets and applications, including but not limited to:

- Home (security, appliances, automation);
- Industrial and utilities (process control, machine-to-machine automation, logistics);
- Transportation (aircraft, railroad and light rail, vehicular);
- Agriculture (soil and crop management, livestock care);
- Government and military (smart cities, aerospace and defense, and e-Government);
- Healthcare (telemedicine, predictive diagnostics, robotic and image-guided surgery);
- Environmental (weather and climate management and prediction, fire and flood detection, wildlife management);
- Retail (logistics, inventory control, security); and
- Building and construction (fault prediction, energy management, and heavy machinery control).

Today, in the Latin American/Caribbean region, Brazil hosts just under half of regional IoT devices, with Mexico and Colombia representing the next two largest users. The rest of Latin America and the Caribbean, in total, comprises 20 to 25 percent of current IoT device usage. IoT

[80] I-Scoop.eu

adoption in Central America and the Caribbean is limited currently but poised for rapid growth, particularly as cellular technologies and cost-effective broadband access continue to evolve.

A5.1.2 Artificial Intelligence

Artificial Intelligence (AI) is the simulation of human cognitive capabilities in machines programmed to think and mimic the actions of people. Any machine exhibiting traits associated with a human mind, such as learning and problem-solving, may be described as using artificial intelligence. The key characteristic of AI is its ability to rationalize and take actions having an optimized chance of achieving a specific goal.

Artificial intelligence divides into two categories:

- **Weak:** a system designed to carry out one particular job (e.g., playing chess or personal assistants such as Amazon's Alexa or Apple's Siri where the assistant is asked a question and answers it); and
- **Strong:** typically complex systems performing multiple tasks considered human-like, programmed to handle situations requiring problem solutions without human intervention. (e.g., self-driving cars or robotic and image-guided surgery).

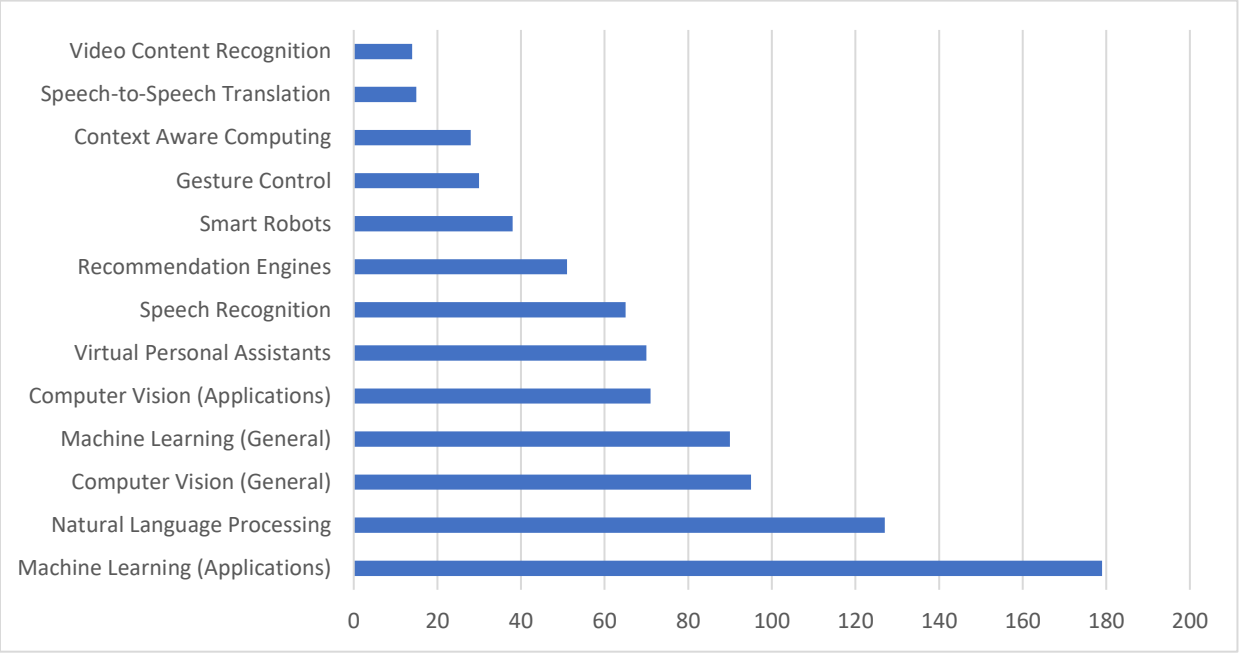
AI technologies are evolving rapidly. Over 800 companies are developing AI technologies and solutions spanning: machine learning; computer visioning; language processing, recognition and translation; and movement and context recognition and interpretation (*Figure 40*).

AI solutions offer benefits including:

- Labor and home/personal management cost reduction;
- Worker safety (e.g., allowing machines to replace humans in risky environments);
- Ability to perform tasks more quickly and effectively than the average human (e.g., reading digital medical images and performing complex surgeries); and
- Scalability and 24/7/365 service availability and access from any location.

Since the start, however, AI has come under scrutiny from scientists and the public. A key issue is the replacement of human labor by machines, potentially leading to mass unemployment. Another concern is that machines may become so highly developed that humans will not be able to keep up with machine learning, creating a prospect that machines could evolve themselves to take over society. Yet another is that AI devices may have the ability to hack into human privacy or be weaponized. Many debate the ethics of artificial intelligence and how intelligent systems should be treated legally vis-à-vis human rights.

Figure 40: Artificial Intelligence Innovation Areas, 2020 (Number of Companies Developing Solutions)[81]



For the Latin America and Caribbean region, which has historically lagged larger economy regions in worker productivity, AI offers an opportunity to leapfrog to greater innovation and economic progress. Research suggests AI can add a full percentage point of GDP to five of South America's largest economies (Argentina, Brazil, Chile, Colombia, and Peru) by 2035.[82] By year-end 2019, 79 percent of Latin American companies had launched AI initiatives, with fewer than two percent reporting lower than expected investment returns.[83]

A5.1.2 Digital Payment Systems

Electronic payments allow customers to pay for products or services online. An e-commerce payment system facilitates transactions seamlessly among several parties:

- The account holder, or consumer**,** who purchases a product or service online;
- The merchant who sells goods and services to the consumer;
- The issuer (the financial institution providing the consumer with a payment account and/or card).
- The acquirer (the merchant account provider, the financial institution that establishes an account with the merchant). The acquirer authorizes the legitimacy of the consumer account.
- The payments processor, who handles the official transaction between the consumer and the merchant; and
- The payment gateway (processes merchant payment messages and uses security protocols and encryptions to ensure transaction safety).

[81] Venture Scanner
[82] Inter-American Development Bank
[83] Massachusetts Institute of Technology (MIT)

Artificial Intelligence is gaining momentum in the digital payments market, both in backend operations and customer-facing payment systems. AI digital payment applications include:

- Fraud protection facial recognition;
- Smarter Stan-In Processing (Smarter STIP) and other technologies to ensure fast interruption-free transaction; and
- Fraud-resilient settlement technology with transaction pattern recognition, human error reduction, and AI-enhanced cybersecurity.

In the private sector, the GraceKennedy Digital Transformation project in Jamaica, described earlier in this Resource Guide, is applying Digital Payments technology to improve the efficiency and effectiveness of its global business. Four public sector digital payments-related projects are addressed in the Smart Cities and e-Government discussion preceding this section.

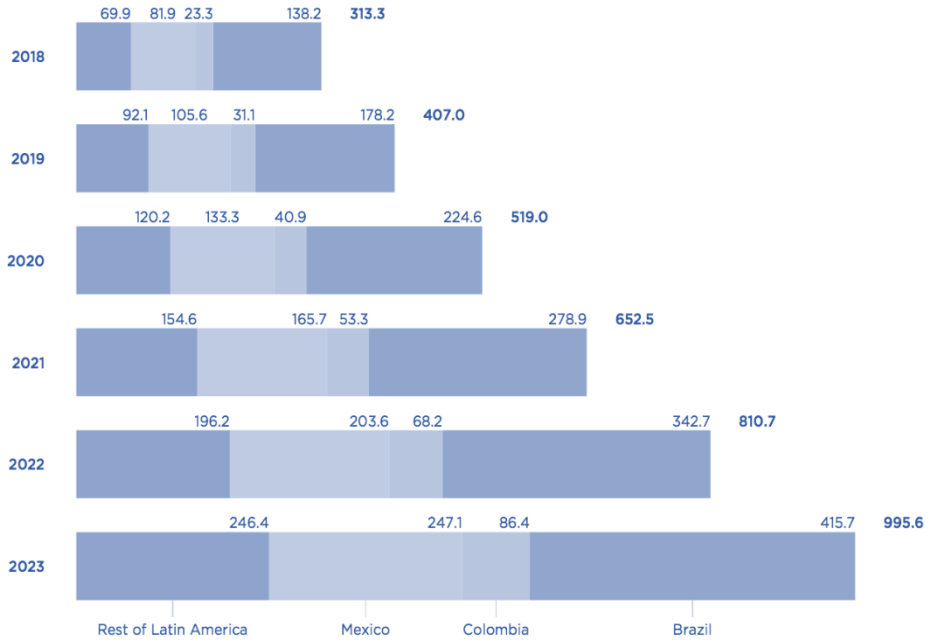
A5.2 Internet of Things (IoT) and Artificial Intelligence (AI) Investment Outlook

In 2019, the global market for IoT was approximately $745 billion.[84] By 2025, projections suggest 41.6 billion IoT devices will be connected globally, generating 79.4 zettabytes of data. Global spending will exceed $1 trillion by 2022.[85]

In 2017, the Latin American/Caribbean region hosted 400 million connected devices. By 2023, MIT forecasts that number will reach over one billion connected IoT devices. The region will represent the fastest growth in IoT spending through 2025. While Brazil is and will remain the largest IoT device consumer, Mexico (28.3 percent compound annual growth rate (CAGR)), Colombia (24.9 percent CAGR), and Chile (23.3 percent CAGR) are projected to lead growth in the region (*Figure 41*). Several Central American and Caribbean countries have begun adopting AI technologies, with projects in Costa Rica, El Salvador, and Jamaica profiled in this Resource Guide.

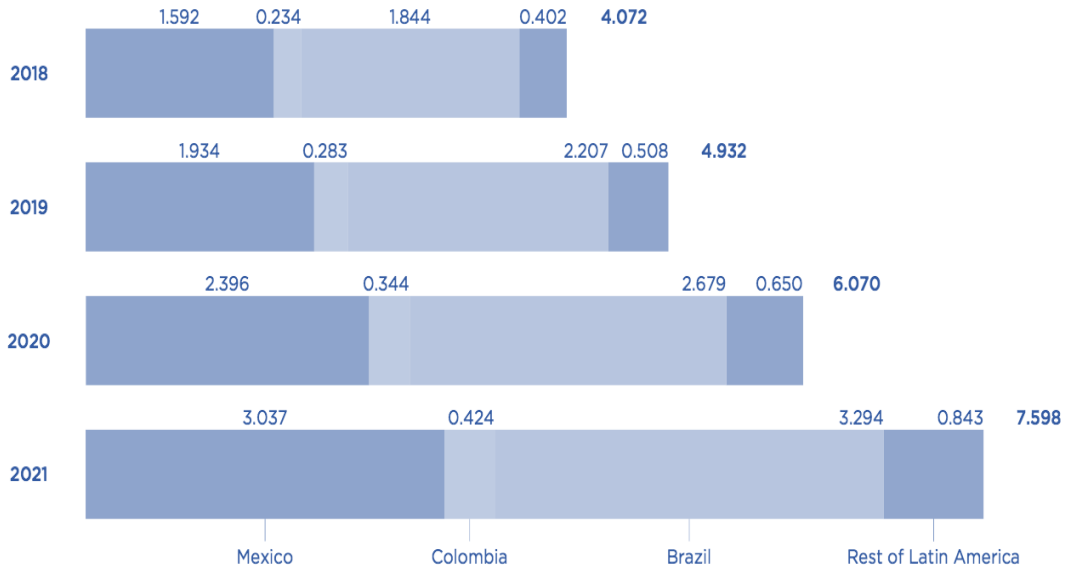
[84] Ibid
[85] Ibid

Figure 41: Latin America and Caribbean Internet of Things (IoT) Device Forecast, 2018-2023 (million units)[86]



The foregoing device numbers translate to a regional market of almost $5 billion in 2019. The Latin American/Caribbean region IoT market will grow to $7.6 billion by 2022, or at a compound annual growth rate of above 20 percent (*Figure 42*).

Figure 42: Latin American and Caribbean Internet of Things (IoT) Revenue Forecast, 2018-2023 ($ billion)[87]



[86] Ibid
[87] Inter-American Development Bank

Although the Latin American/Caribbean region AI market is small today (various estimates suggest under $1 billion in 2019), the geography is already seeing substantial economic benefits from artificial intelligence. Growth will be driven by several factors, with big data providing traction and image processing being a critical application area. The large amount of data required to train AI systems for character and image recognition has, to date, constrained growth. Visa, for example, reported that artificial intelligence allowed regional financial institutions to avoid $2 billion in credit card fraud in 2019 on a payment volume of $430 billion.

Following are profiles of the countries that have projects profiled in this Resource Guide.

A5.3 Costa Rica

Costa Rica has begun IoT and AI implementations through its various smart cities efforts and in the private sector. The city of Cartago, for example, is modernizing technological infrastructure and implementing digital service payments. In a project profiled earlier in this Resource Guide, San José is developing a technology park, Innovation District 24, featuring artificial intelligence, big data, and the development of creative industries based on ICT technologies.

As a regional leader in the U.S. "nearshore outsourcing," Costa Rica has attracted technology companies including Microsoft, an anchor tenant in Innovation District 24, and Intel, with the largest microchip facility in the region. GBT Technologies, a technology company historically focusing on chip design and software, is developing a portfolio of intellectual property targeted to have relevance in enabling the rollout of IoT (Internet of Things), global mesh networks, and artificial intelligence applications. GBT has chosen Costa Rica to test its Avant! AI Virtual Agent product. AI Virtual Agent is a device capable of understanding questions, searching for relevant information to perform analyses, and advising with the most reasonable conclusions. Potential applications include healthcare, engineering design, customer service, and financial analytics.

A5.4 El Salvador

El Salvador is early in adopting IoT and AI technologies, but momentum is building as broadband access and associated costs improve. One of the country's earliest uses of IoT technology was in mudslide detection, allowing early warnings of impending natural disasters to previously telecommunications-challenged areas.

Two projects featured in this Resource Guide feature IoT and AI technologies:

- *International Airport Upgrade*: as critical parts of El Salvador's San Óscar Arnulfo Romero y Galdámez International Airport (AEIS-SOARG) upgrade, IoT and AI technologies will be deployed for perimeter control (including biometrics), facial recognition of passengers for immigration control, and within meteorological and bird sensing applications.
- *Semi-Automation of Containers at Acajutla Port*: in the upgrade to automate container handling at Acajutla Port, IoT, and AI technologies will be deployed to improve real-time container tracking, integrating port operations with management, and demand and supply forecasting.

A5.5 Jamaica

Jamaica, too, is implementing IoT and AI technologies in both the public and private sectors. For example, the Jamaica Customs Agency (JCA) has already implemented several modernization initiatives for trade facilitation and border security. The JCA has implemented the Automated System for Customs Data (ASYCUDA) in a move to a more paperless environment for processing customs declarations. The ASYCUDA includes AI risk management tools to mitigate threats to security and revenue loss. To foster greater compliance among trade-related stakeholders, the JCA has also highlighted supply chain security through shared responsibility between customs and relevant private sector entities.

A private-sector example, the GraceKennedy corporate Digital Transformation project, reviewed earlier in this Resource Guide, will include advanced technologies for improved customer experience and operational efficiency. Important foci will be digital payment systems and interactions with the Bank of Jamaica's fintech regulatory Sandbox.

A6 Cybersecurity

A6.1 Sector Overview

Cybersecurity emphasizes the safeguarding of computers, programs, networks, and data from unlicensed and spontaneous access. The sector includes:

- Network security;
- Application security;
- Endpoint security;
- Identity management;
- Data security;
- Cloud security; and
- Infrastructure security.

As for many other ICT segments, providers typically supply articles of commerce in the forms of hardware, software, and services.

Cybersecurity threats, commonly known as malware, can infiltrate the software of any device. These threats take many forms, including[88]:

- ***Viruses:*** malware that propagates by inserting a copy of itself into and becoming part of another program. It spreads from one computer to another, leaving infections as it travels. Almost all viruses are attached to an executable file, so the virus may exist on a system but not spread until a user runs or opens the malicious host file or program. Viruses spread when the software or document they are attached to is transferred from one computer to another using the network, a disk, file sharing, or infected e-mail attachments.
- ***Worms:*** similar to viruses in replicating functional copies of themselves; however, viruses require spreading an infected host file, while worms are standalone software and do not require a host program or human help to propagate.

[88] Cisco

- ***Trojans:*** malware named after the wooden horse that the Greeks used to infiltrate Troy. A Trojan is a harmful piece of software that looks legitimate. A Trojan can achieve any number of attacks on the host, from irritating the user (popping up windows or changing desktops) to damaging the host (deleting files, stealing data, or activating and spreading other malware, such as viruses). Trojans are also known to create backdoors to give malicious users access to the system. Unlike viruses and worms, Trojans do not infect other files or self-replicate. Trojans spread through user interactions like opening an email attachment or downloading and running a file from the internet.
- ***Spyware:*** software that "spies" on a device, capturing information including web browsing habits, e-mail messages, usernames and passwords, and credit card information. If left unchecked, spyware can transmit this data to another person's computer over the Internet. Users typically install spyware by opening an e-mail attachment containing the malicious software.
- ***Ransomware:*** threatens to publish the victim's data or perpetually block access unless a ransom is paid. Advanced ransomware uses *cryptoviral extortion*, encrypting the victim's files, making them inaccessible, and demanding a ransom payment to decrypt them.
- ***Bots*****:** from the word "robot," an automated process interacting with other network services. A typical use of bots is to gather information (e.g., web crawlers or interact automatically with messaging and chat software or other web interfaces. Bots may be used for either legitimate or malicious intent. A malicious bot is self-propagating malware designed to infect a host and connect back to a central server or servers that act as a command and control (C&C) center for an entire network of compromised devices, or "botnet." With a botnet, attackers can launch broad-based, "remote-control," flood-type attacks against their target(s). Bots can include the ability to log keystrokes, gather passwords, capture and analyze packets, gather financial information, launch Denial of Service attacks, relay spam, and open backdoors on the infected host. Advanced botnets can take advantage of internet of things (IoT) devices, like home electronics or appliances. Crypto mining is a common malicious use of bots.

Recent history suggests the following concerning cybersecurity threats[89]:

- 88% of organizations worldwide experienced spear-phishing attempts in 2019.
- 68% of business leaders feel their cybersecurity risks are increasing.
- On average, only 5% of companies' folders are adequately protected.
- Data breaches exposed 36 billion records in the first half of 2020.
- 86% of breaches were financially motivated, and 10% were motivated by espionage.
- 45% of breaches featured hacking, 17% involved malware, and 22% involved phishing.
- Between January 1, 2005, and May 31, 2020, there were 11,762 recorded breaches.
- The top malicious email attachment types are .doc and .dot, which make up 37%, the next most experienced file type is .exe at 19.5%.
- An estimated 300 billion passwords are used by humans and machines worldwide.

As cyber threats have increased in sophistication and at rapid rates, security solutions have gained traction globally. Offerings such as antivirus software and firewalls have grown in complexity and proven to be effective at preventing threats, including malware, Trojans, and phishing. The success

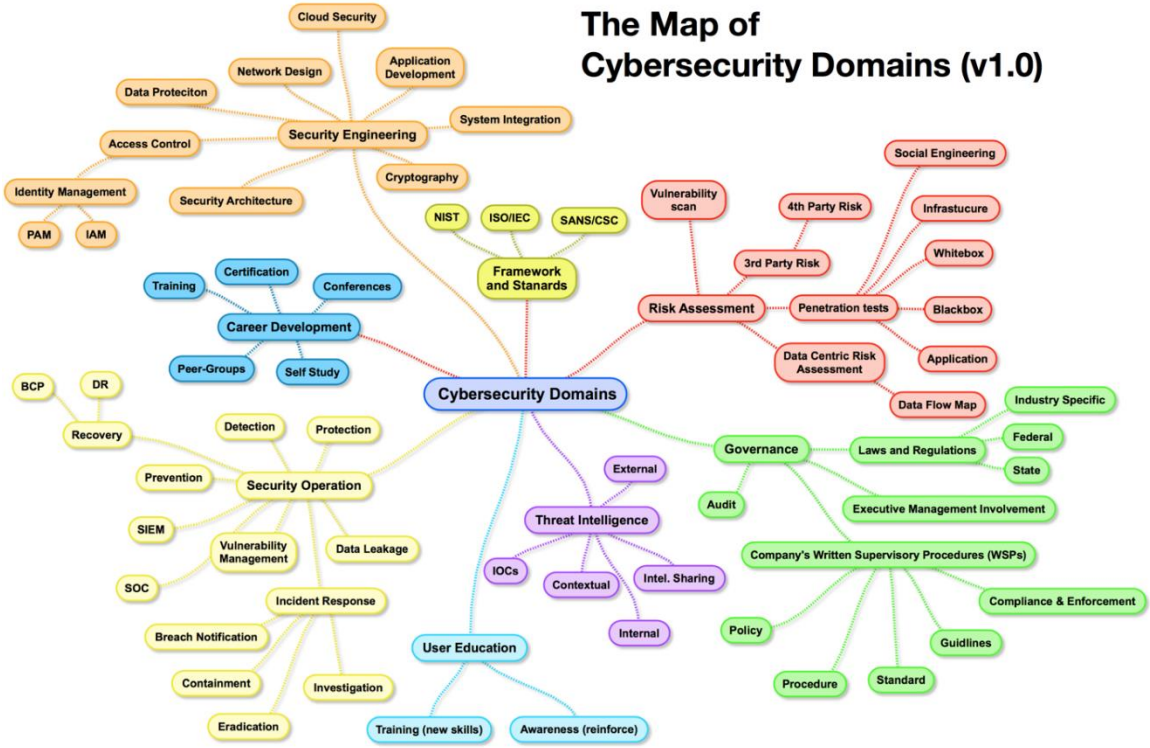
[89] Varonis https://www.varonis.com/blog/cybersecurity-statistics/

of early solutions led to the rapid development of the cybersecurity industry. Implementing technical defenses has become a standard best practice in every enterprise.

The breadth of cybersecurity considerations is described in Figure 43. Focal areas include:

- Risk assessment;
- Governance;
- Threat intelligence;
- Security operations;
- Security engineering;
- User education; and
- Career development.

Figure 43: Cybersecurity Domains[90]



Future considerations for managing cybersecurity include:

- Remote workers will continue to be a target for cybercriminals.
- As a side effect of remote workforces, cloud breaches are likely to increase.
- As a result of 5G increasing the bandwidth of connected devices, IoT devices will become more vulnerable to cyberattacks.
- DNS over HTTPS is likely to become a common attack vector given the ability to encrypt malicious requests, so they are masked from security controls.

[90] Tao Security https://taosecurity.blogspot.com/2017/03/cybersecurity-domains-mind-map.html

- Disinformation campaigns are likely to continue and grow.
- Attacks on cars and operational technologies will continue to proliferate due to less mature security controls.
- There is a widening talent gap, with demand outstripping the supply of needed personnel.

By 2019, eighteen Latin America and Caribbean region countries had made efforts to frame cybersecurity strategies, with twelve in place and operational. Belize will soon join the list.

In Latin America, Argentina, Mexico, and Brazil were among the countries with the highest percentages of internet users and mobile devices affected by malware. In 2019, Ecuador and Paraguay suffered the most significant number of cybersecurity incidents. Seventy percent of IT managers of companies in these two countries indicated addressing incidents including malware infections, unauthorized access to applications, and unauthorized access to databases. In Brazil, 65 percent of organizations reported suffering ransomware attacks in 2020, compared to 44 percent in each of Mexico and Colombia.[91]

Important cybersecurity challenges in the Central America and Caribbean sub-region include:

- The sophistication of ICT technologies and broadband speeds;
- The ability to defend against foreign interests targeting the region; and
- The availability of cybersecurity talent.

A6.2 Cybersecurity Investment Outlook

In 2019, the global market for Cybersecurity solutions was approximately $150 billion, according to various sources.[92] Estimates project market growth at an annual rate of at least 10 percent over the next five years.

Cybercrime costs have quadrupled since 2015, reaching $2.1 trillion by the end of 2019 and outpacing spending on cybersecurity by over 16 times. The COVID-19 global pandemic posed challenges to the already rapid growth of the sector by requiring the swift adoption of remote working technologies with concomitant needs for safeguarding business data, preventing losses from cyberattacks, and managing the spike in demand for robust authentication methods over vastly more workplaces.

The Latin America and Caribbean cybersecurity market was approximately $5 billion in 2020 and is projected to double by 2026.[93] In 2017, the Latin American/Caribbean region hosted 400 million connected devices. By 2023, MIT forecasts that number will reach over one billion. The region will represent the fastest growth in IoT spending through 2025, which poses rapidly expanding cybersecurity risks. While Brazil will remain the largest device consumer, Mexico, Colombia and Chile are projected to lead growth in the region. The typically smaller average country sizes in the Central America and Caribbean sub-region provide unique cybersecurity

[91] Statista
[92] Ibid
[93] Mordor Intelligence

challenges as economies of scale generally are unavailable. The Organization of Eastern Caribbean States (OECS) is developing a project (profiled in the OECS section of this report) to address, among other ICT issues, cybersecurity across four smaller countries, as is Belize.

A6.3 Belize

With the growth of connectivity, the dependence on Internet-based platforms has also grown and increased exposure to cyber-related crimes in Belize. The Police Information Technology and Cyber Unit (PITCU) of the Belize Police Department (BPD) manages the investigations of cyber-related crimes and felonies involving electronic evidence. The PITCU has investigated phishing, credit card, and ATM fraud cases and has received reports of cyberbullying and identity theft. The agency also participates in an international collaboration to counter cybercriminal activities, including reporting cases of child pornography.

Cybersecurity has become an increasing part of the national dialogue in Belize, with the government holding discussions to address the issue among different country sectors. Since 2014, the Ministry of National Security has been working on coordinating a cybersecurity response at the national level and had organized a Cybersecurity Ad Hoc Committee, made up of multiple stakeholders, including academia and the private sector, to work together on building awareness about cybersecurity and cybercrime in Belize. Since then, an inter-institutional cybersecurity task force was established in 2018 and was instrumental in developing the Belize National Cybersecurity Strategy, 2020-2023.

Today**,** there is no comprehensive criminal legislation strictly addressing cybercrime in Belize. Thus, the prosecution of these crimes has been difficult. With the legislative gap, there is a need for the development of a comprehensive cybercrime bill.

The Belize National Cybersecurity Strategy, 2020-2023 was published in November 2020. The Belize country section of this Resource Guide reviews the project to implement the strategy. The strategic implementation comprises three key priorities:

- Develop the national legal framework to address cybersecurity threats adequately;
- Develop national capacity for incident response and protection of critical information infrastructure; and
- Implement measures to support education, awareness, and workforce development.

The Belize Police Department (Ministry of National Security) and the Central Information Technology Office (CITO, within the Ministry of Finance) hold principal responsibilities for implementation.

A6.4 Organization of Eastern Caribbean States (OECS)

Smaller and less diversified economies in the Caribbean are most affected by the demand (reduced consumer spending) and supply (cancellation of flights and cruises) shocks to tourism due to COVID-19. While the competitiveness of the services sector increasingly relies on technology and digital platforms to serve modern consumer demands, few OECS businesses are rising to this challenge. Further, few local workers have the technology and soft skills needed to drive a digital transformation. In 2018, the International Telecommunications Union assessed and indexed global

cybersecurity readiness. The results for several Eastern Caribbean countries are provided in Table 36.

Table 36: ITU Global Cybersecurity Index 2018 – Eastern Caribbean Countries[94]

Country	Score	Regional Rank	Global Rank
Antigua and Barbuda	0.247	17	113
Barbados	0.173	20	127
St. Vincent and the Grenadines	0.169	21	129
Grenada	0.143	23	134
Guyana	0.132	25	138
St. Lucia	0.096	29	149
St. Kitts and Nevis	0.065	30	157
Dominica	0.019	33	172

To address these concerns in four Eastern Caribbean countries (Dominica, Grenada, St. Lucia, and St. Vincent and the Grenadines), the Organization of Eastern Caribbean States (OECS) is undertaking a Caribbean Digital Transformation Project. The project's objective is to increase access to digital services, technologies, and skills by governments, businesses, and individuals in the participating Eastern Caribbean countries. The project is detailed earlier in the OECS section of this Resource Guide and includes a component surrounding cybersecurity to:

- Conduct a cybersecurity policy, regulatory, and institutional review;
- Create national-level cybersecurity agencies and emergency response teams;
- Coordinate regional capacity building; and
- Update regional and national data protection and privacy laws.

[94] KPMG https://assets.kpmg/content/dam/kpmg/bb/pdf/2019/11/cybersecurity_and_trust_in_the_caribbean.pdf

Annex B: List of Acronyms

ACRONYM	DEFINITION
2G	Second Generation Cellular Network
3G	Third Generation Cellular Network
4G	Fourth Generation Cellular Network
5G	Fifth Generation Cellular Network
6G	Sixth Generation Cellular Network
A4AI	Alliance for Affordable Internet
ADAS	Advanced Driver Assistance Systems
AEIS-SOARG	San Óscar Arnulfo Romero y Galdámez International Airport
AI	Artificial Intelligence
AMI	Advanced Metering Infrastructure
AMPS	Advanced Mobile Phone Service
ATIS	Automatic Terminal Information System
ATM	Automatic Telling Machine
ATMS	Advanced Traffic Management System
AMX-1	America Movil Submarine Cable System-1
AYSCUDA	Automated System for Customs Data
AV	Autonomous Vehicle
AWOS	Automated Weather Observing System
BaaS	Backend as a Service
BCH	Banco Central de Honduras
BDSNi	Bahamas Domestic Submarine Network
BPL	Broadband over Powerlines
BPO	Business Process Outsourcing
C3I	Centro de Control de Ciudad Inteligente
C-RAN	Centralized Radio Network
C&C	Command and Control
CAGR	Compound Annual Growth Rate
CARCIP	Caribbean Regional Communications Infrastructure Program
CARICOM	Caribbean Community
CatIS	Catalog of Interoperability Solutions

CCTV	Closed-Circuit Television
CDMA	Code Division Multiple Access
CEPA	Comisión Ejecutiva Portuaria Autónoma
CFZ-1	Colombia-Florida Subsea Fiber
CINDE	Coalición Costarricense de Iniciativas de Desarrollo
CIO	Intelligent Operations Center
CIRT	Cybersecurity Incident Response Teams
CITO	Central Information Technology Office
CJFS	Cayman Jamaica Fiber System
CONATEL	Conseil National des Telecommunications
CONATEL	Comisión Nacional de Telecomunicaciones
CUPPS	Common-Use Passenger Processing Systems
DFS	Digital Financing Systems
DNS	Domain Name System
DPAPM	Division of Public Administration and Development Management
DOI	Department of Implementation
DR	Dominican Republic
DSL	Digital Subscriber Line
DTCO	District of Technology, Culture, and Opportunities
DTTV	Digital Terrestrial Television
e-ID	Electronic Identification
EA	Enterprise Architecture
EC	European Council
ECFS	Eastern Caribbean Fiber System
EDGE	Enhanced Data Rates for GSM Technology
EGDI	e-Government Development Index
ETED	Empresa de Transmisión Elétrica Dominicana
EV	Electric Vehicle
EVDO	Evolution Data Optimized
EWP	East-West Power Company
FONATEL	Fondo National de Telecomunicaciones (National Telecommunications Fund)
GDP	Gross Domestic Product
GIS	Grenada Information Service
GK	The GraceKennedy Group
GKMS	GraceKennedy Money Services

GNI	Gross National Income
GoB WAN	Government of Belize's Wide Area Network
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications
GTA	Guyana Telecommunication Agency
GTCI	Global Talent Competitiveness Index
GWAN	Global Wide Area Network
HCI	Human Capital Index
HDTV	High-Definition Television
HFT	High-Frequency Trading Financial Service
HRMIS	Human Resource Management Information System
HSPA	High-Speed Packet Access
HTTPS	Hypertext Transfer Protocol Secure
HVAC	Heating Ventilation and Air Conditioning
IaaS	Infrastructure as a Service
IADB	Inter-American Development Bank
IATA	International Air Transport Association
IBRD	International Bank for Reconstruction and Development, World Bank Group
IBRD	International Bank for Redevelopment
ICE	Instituto Costarricense de Electricidad
ICT	Information and Communication Technology
IDA	International Development Association
IESE	Graduate Business School of the University of Navarra, Barcelona, Spain
IFC	International Finance Corporation
IFI	International Financial Institutions
INDOTEL	Instituto Dominicano de Telecomunicaciones
IoT	Internet of Things
IP	Internet Protocol
IPP	Independent Power Producer
IPTV	Internet Protocol Television
IS	Information Systems
ISP	Internet Service Provider
IT	Information Technology
ITCR	Costa Rica Institute of Technology
ITO	Information Technology Outsourcing
ITU	International Telecommunication Union

JCA	Jamaica Customs Agency
JPS	Jamaica Public Service Company
kt	Kiloton
Kbps	Kilobits per Second
LAC	Latin America and the Caribbean
LED	Light-Emitting Diode
LEO	Low Earth Orbit
LLWAS	Low-Level Wind Shear Alert System
LTE	Long-Term Evolution
Mbps	Millions of Bits per Second
MHz	Megahertz
Micitt	Costa Rica Communications Ministry
MIMO	Multiple-Input/Multiple-Output
MOF	Ministry of Finance
MOIID	Ministry of Infrastructure Development, Public Utilities, Energy, Transport and Implementation
MTPTC	Ministry of Public Works, Transportation, and Communication
NCN	National Communications Network
NDMA	National Data Management Authority
NIS	National Identification System
NMT	Nordic Mobile Telephony
NOC	Network Operations Centers
NOMA	Non-Orthogonal Multiple Access
NSCS	National Security Council Secretariat
NTRC	National Telecommunications Regulatory Commission
NTT	Nippon Telephone and Telegraph
NYU	New York University
OAS	Organization of American States
OECS	Organization of Eastern Caribbean States
OMA	Orthogonal Multiple Access
ONTIC	Observatorio Nacional de las Tecnologías de la Información y la Comunicación
OSI	Online Service Index
OTT	Over-the-Top Telecommunications Provider
OUR	Office of Utilities Regulation

PaaS	Platform as a Service
PAC	Pan American Crossing
PBX	Private Branch Exchange
PITCU	Police Information Technology and Cyber Unit
PKI	Public Key Infrastructure
PoP	Point of Presence
PPP	Public Private Partnership
PROESA	Organismo Promotor de Expertaciones e Inversiones de El Salavador
PSTN	Public Switched Telephone Network
PUC	Public Utilities Commission
QR	Quick Response
R&D	Research and Development
RFID	Radio-Frequency Identification
RFS	Ready for Service
RFP	Request for Proposal
RTT	Real-Time Text
SaaS	Software as a Service
SDP	Spatial Data Platform
SDM	Spatial Digital Multiplexing
SEUL	Strategic Evolution Underwater Link
SG-SCS	Suriname-Guyana Submarine Cable System
SIGET	Superintendencia General de Electricidad y Telecomunicaciones
Smarter STIP	Smarter Stan-In Processing
SOC	Security Operations Center
sq km	Square Kilometer
STS	Ship-to-Shore
SUTEL	Superintendencia de Telecomunicaciones (Telecommunications Superintendency)
TA	Technical Assistance
TACS	Total Access Communication System
Tbps	Terabytes per Second
TDMA	Time Division Multiple Access
TEC	Technological Institute of Costa Rica, Tecnológico de Costa Rica
TII	Telecommunication Infrastructure Index
TV	Television
	The Central Project Execution Unit

UCE	
UK	United Kingdom
UCLA	The University of California at Los Angeles
UMTS	Universal Mobile Telecommunications System
UN-DESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Program
UPS	Uninterruptible Power Supply
US	United States
USD	United States Dollar
USTDA	United States Trade and Development Agency
VHF	Very High Frequency
WAN	Wide Area Network
WiFi	Wireless Fidelity
WiMAX	Worldwide Interoperability for Microwave Access